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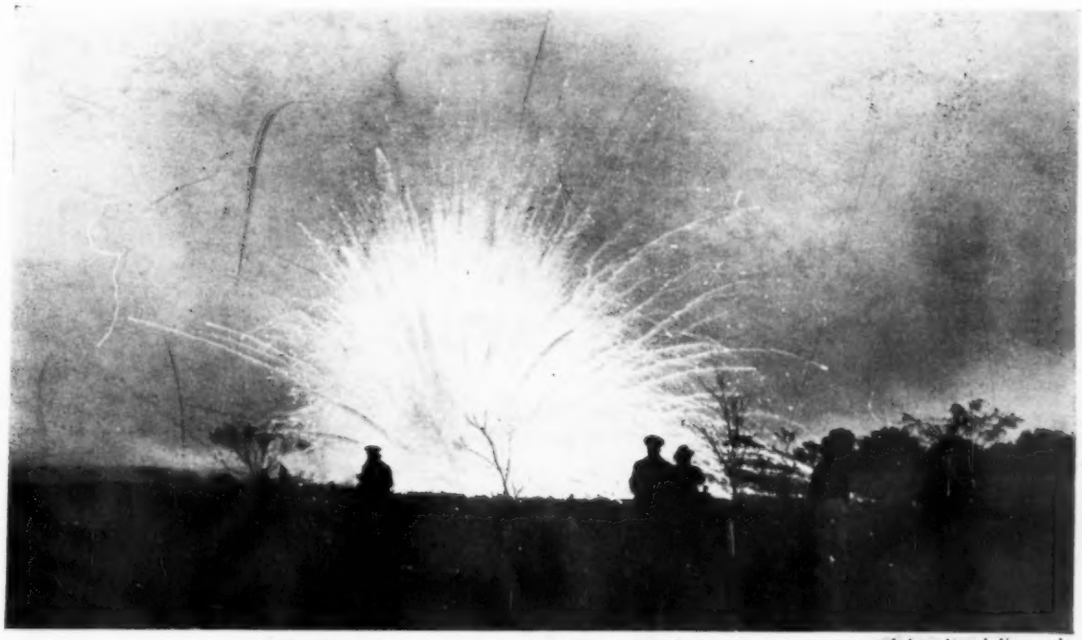
VOL. VIII WASHINGTON, D. C., JULY-AUGUST, 1927 No. 43



A PHOSPHORUS BOMB CHANGES TWILIGHT TO NOON *International Newsreel*

THE ARMY INDUSTRIAL COLLEGE

A STANDARD METHOD FOR MEASURING SMALL ARMS TARGETS
Capt. F. J. Jervey, Ord. Res., U. S. A.

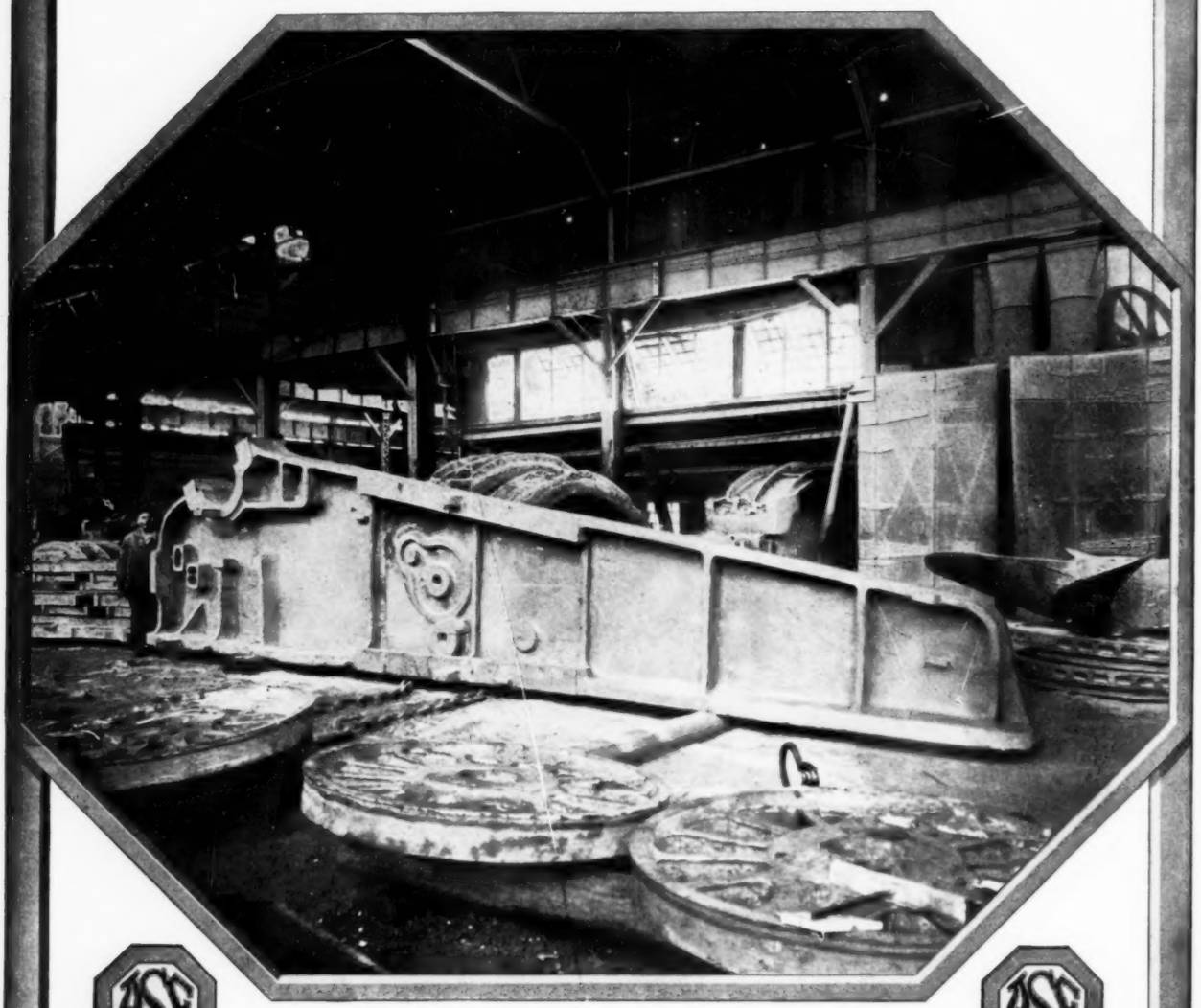
THE MAINTENANCE OF ARMAMENT
Maj. R. W. Pinger, Ord. Dept., U. S. A.

PROGRESS IN THE STANDARDIZATION OF ORDNANCE SPECIFICATIONS
Maj. C. A. Walker, Ord. Dept., U. S. A.

TROPHIES FOR AMERICAN RIFLEMEN

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

AMERICAN STEEL FOUNDRIES



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ARMY ORDNANCE

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

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Published by
THE ARMY ORDNANCE ASSOCIATION
806 Mills Building, Washington, D. C.

Issued Bi-Monthly. Single Copy 75c.
Subscription rate: Continental U. S. $4.50 per annum, foreign $5.00, in advance; Entered as second class matter August 14, 1920, at the Post Office at Washington, D. C., under the Act of March 3, 1879. Additional entry at Richmond, Va.

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"The increasing interest all over the nation in industrial preparedness is a frank declaration to the world that we not only want peace but that we intend to have it."

HANFORD MACNIDER, *Assistant Secretary of War.*

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THE Army Ordnance Association is a national organization of American citizens pledged to industrial preparedness for war as our nation's strongest guarantee of peace.

THE Association endeavors to keep alive an interest in and knowledge of the design, production and maintenance of munitions. Other than a few manufacturing arsenals—six in all—there is no peace-time industry for the production of ordnance. Should war unhappily come again, industrial America will be called upon to produce munitions in great quantity and of intricate and unusual design. In an emergency time will not permit careful study or long preparation for the production of munitions. The problem is one of vital concern.

THE Army Ordnance Association believes that the solution of this problem, based on experience, lies in an active organization at all times cooperating with the Government. The principal objective of the Association is an active membership of American citizens, on whom the duty of design and production of munitions will fall in war, who will have an accurate and authentic knowledge of the complex requirements of ordnance. "Peace Insurance" in this form is the foremost aim of the Army Ordnance Association.

THE Association is purely patriotic; it has no commercial interests, no political alliances, and no religious affiliations. It is not operated for profit: its income is expended in furthering its aims. Its officers and directors serve without remuneration.

ARMY ORDNANCE, the journal of the Association, is published solely for the purpose of disseminating information on the progress of our munitions developments so that American industry may at all times know its responsibilities to the common defense.

The objectives of the Association as set forth in its Constitution are:

To assist in effecting industrial preparedness for war as being one of the nation's strongest guarantees of peace;

To keep available the highly specialized knowledge necessary for arming the manhood of the nation by stimulating interest in the design and production of ordnance material;

To promote mutual understanding and to effect cooperation with American Scientists, Inventors, Engineers and Manufacturers in civil life and the Regular and Reserve Officers of the Army Ordnance Department;

To provide, when required, the services of competent committees to investigate and report upon special ordnance subjects;

To assist in developing and maintaining an efficient personnel, both commissioned and enlisted, for the units required for Ordnance Field Service in the event of an emergency;

To commemorate the services rendered by the Industry of the Nation and by the Officers and Civilian Employees of the Ordnance Department in the wars in which the United States has been engaged.

Communications should be addressed to
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The Ninth Annual Meeting

of the

Army Ordnance Association

will be held at

The Aberdeen Proving Ground, Maryland

Thursday, October 6, 1927

We are privileged to have with us as participating guests:

The Society of Automotive Engineers

The American Society for Testing Materials

The Military Order of the World War

Further announcement as to the program of events, special trains, reduced railroad rates and meals will be published in the September-October issue of Army Ordnance.

Members of the Army Ordnance Association and guests will receive personal invitations and other data in due course.

Reserve This Date
October 6, 1927

ARMY ORDNANCE

VOL. VIII JULY-AUGUST, 1927 No. 43

The Army Industrial College

An Unique Institution Where Officers of the Services Study the Economic Phases of War

THE American plan of government now claims as one of the established components of its national defense system, The Army Industrial College, an educational institution devoted exclusively to the study of the economics of war.

Strange as it may seem, in the past the economic aspect of war was never given its proportionate place of importance in the scheme of national defense either in this country or, as far as is known, in any other country. Military tactics, strategy and organization always claimed major attention. Our military leaders were taught the science of battle, the technique of command, the art of maneuver—all of them excellently taught and, as our history proves, as proficiently learned. But with the World War came the consciousness, made manifest by sheer lack of industrial preparedness, that modern war is waged as relentlessly and none the less vitally in the manufacturing plants of the nation, at the draftsman's table and in the industrial executive's board room as it is on the actual scene of conflict. In 1918 it was found to the dismay of the nation that the citizenry of America could be mobilized, trained, transported and marshalled on the front on a stupendous scale but that the industries of America could not keep step. In spite of our vast industrial strength, we were compelled to borrow the sinews of war until machines could come apace with men. It was a bitter lesson and heroic efforts were made in those days to find the remedy.

The remedy was all too apparent, but for lack of time, previous planning and organization, it was impossible of attainment. With a feeling of just pride, it may be said that the Army Ordnance Association was established to help American industry do its share in solving this transcendent problem. The Army Industrial College was brought into being for a like purpose: to enable the officers of the Services to do their share by studying the war-time industrial efforts of the past and, based on that study, by advance planning for the war-time industrial requirements of the future.

The Army Industrial College is three years old, having been organized in February, 1924, when Secretary of War Dwight F. Davis was Assistant Secretary of War. The announced purpose of the school is the training of Army officers in the useful knowledge pertaining to the supervision of procurement of all military supplies in time of war and to the assurance of adequate provision for the mobilization of matériel and industrial organizations essential to war-time needs. The direct supervision and control of the College are vested in the Assistant Secretary of War.

The class of 1926-1927 was the sixth to graduate, the length of the previous courses having been but five months each. The present and future courses are of ten months duration. The first class consisted of nine officers, the second class of thirteen officers, and so on to the present class which consisted of thirty-five officers including one from the Navy and one from the Marine Corps. Including the class of 1927 the college has graduated one hundred and thirty-three officers. The officers come from the seven supply branches, and the Finance Department of the Army and the Navy and Marine Corps. The College Staff consists of a Commandant, Col. H. B. Ferguson, C. E., and Assistant Commandant, Col. Irving J. Carr, S. C., and three instructors, one of whom is the executive officer. One of the instructors is a graduate of the Harvard School of Business Administration and the third a member of the Planning Branch, Office of the Assistant Secretary of War.

The Industrial College Curriculum

The first half of the course is generally devoted to individual fundamental problems and the second half to committee problems on more detailed phases of the work. The problems average three weeks in length and are designed to create initiative and individual thought and research. Each solution is presented in conference and is discussed from all viewpoints. Most of the committee problems cover live, current situations and are of value to all officers concerned in planning, both in the Office of the Assistant Secretary of War and in the branches. Lectures from the best available civilian and military authorities are interspersed at pertinent points in the development of the course.

The students of the Army Industrial College are required to attend such lectures of the War College as have a direct bearing on the problem of procurement, particularly those given in connection with the Assistant Secretary of War Course at that institution. Studies made at the War College are utilized wherever practicable throughout the course at the Army Industrial College and students are encouraged to confer with members of the General Staff when information can be obtained from that source.

Lectures by members of other Government Departments, such as the Bureaus of Standards, the Census, Labor Statistics, Foreign and Domestic Commerce, the Tariff Commission, Division of Simplified Practice, and the like, are given to acquaint students with the nature of the assistance which these agencies can render in procurement planning. The services of the Institute of Economics and other private agencies are utilized in the same manner.

During the year the College has attended sixty-nine lectures on various subjects. One week during the course is devoted to inspection trips to various industrial centers.

The problems for the Course 1926-1927 were:

Problem No. 1—"Report Writing."

A study by each student of methods of analyzing business problems and of writing reports embodying their solution. The methods developed are applied in all written reports throughout the course. (Adopted from Harvard School of Business Administration.)

Problem No. 2—"The Problem of War Procurement."

An individual study of the history of our industrial effort in the World War, the difficulties encountered, how they were overcome, the agencies created to handle those difficulties and the organization and operation of those agencies.

Problem No. 3—"War Department Organization for Industrial Mobilization."

An individual problem on the present set-up of the War Department for procurement planning, from the Secretary of War on down through the supply branches to their respective procurement districts. The problem covers the interrelation of the War Department agencies and how they all tie in with War Plans, from the General Mobilization Plan on through the War Plans of the Assistant Secretary of War and those of the branches. This subject is further considered in two committee problems (Nos. 4 and 5) which run concurrently with Problem No. 3.

Harris & Ewing.

Hon. Dwight F. Davis, Secretary of War, under whose direction the Army Industrial College was established in 1924.

Problem No. 4—"Army and Navy Munitions Board and Joint Army and Navy Board."

A committee problem on the organization and functions of each of these Boards and their relation to the work of the Assistant Secretary of War.

Problem No. 5—"Relations of the Office of the Assistant Secretary of War and the General Staff."

A committee problem which discusses the responsibility of each of these agencies and their coordination. Officers from G-4 and War Plans Division, General Staff, present the General Staff viewpoint while the problem is under consideration.

Problem No. 6—"Principles of Organization."

An individual problem to bring out the generally accepted principles of organization and operation as disclosed by a study of commercial practice, and to compare the War Department scheme of war procurement with the principles so enunciated.

Problem No. 7—"Business Fundamentals."

Individual studies consisting of a condensed course of the Harvard School of Business Administration and conducted by a graduate of that institution. The purpose in these studies is to give all procurement officers a general view of business practice, terminology and problems, so as to better qualify Army officers to talk intelligently with manufacturers in presenting their procurement problems and programs.

The business course begins with a study of the general principles of economics and develops particularly the fundamental laws of demand and supply especially in regard to their bearing on price control. The application of economics to business is then brought out by presenting a few business problems involving the basic principles of economics.

The financial organization and operation of industrial companies is then studied and the functions performed by the commercial bank and Federal Reserve System are brought out for the purpose of indicating how financial aid to industry in war can be provided.

The fundamentals of accounting are studied for the purpose of indicating what information the accountant can furnish the executive.

A relatively large proportion of the total time given to the business course is devoted to the study of statistics and statistical methods for the reason that the subject includes the means by which information regarding any business

activity is obtained and through which control is exercised.

The organization of industry for distribution of its products is then covered under the subject of marketing. The study brings out especially the normal routes taken by commodities from producer to consumer and the agencies with which the Army would deal in procuring them.

Finally, the subject of contract law and government contracts is touched upon for the purpose of acquainting the students with the legal aspects of procurement.

Problem No. 8 — "Current Procurement Methods of the Supply Branches."

An individual problem designed to familiarize the student with the current procurement methods of the supply branches. It includes the steps taken to procure specific items and the making out of all papers connected therewith. The conference on this problem compares the procedure in the different supply branches.

Problem No. 9 — "Specifications."

An individual problem to acquaint the student with the existing agencies for the determination of types, the preparation of specifications and the routine followed. It includes study of the principles of standardization and simplification, and the agencies, both governmental and industrial, engaged in this work. World War experience in the effect of unnecessarily severe specifications on production is also covered.

Hon. Hanford MacNider, Assistant Secretary of War, who has direct supervision and control of the Army Industrial College.

Problem No. 10—"Requirements."

An individual study of the basis on which war requirements are computed in the student's branch, the factors to be considered and the actual computation of the requirements of a specific item for the first twelve months under the General Mobilization Plan.

Problem No. 11—"Regulations for Requirements."

A committee problem concurrent with Problem No. 10 and a study of existing instructions pertaining to computation of requirements, to bring out the adequacy and soundness of such instructions and to make a comparison of the basis of computation used by the different branches.

Problem No. 12—"Integrated Industry."

A problem designed to compare the principles of organization and operation underlying integration in industry with those being followed in planning for war procurement.

Problem No. 13—"Orientation War Game."

An exercise, participated in by all students, which consists of a short oral treatment of a few situations probable in war to show the functions of the different sections of the Office of the Assistant Secretary of War, of the branches and of their procurement districts and the interrelations of these agencies.

Problem No. 14 — "Allocation of Facilities."

A discussion of the principles which should be followed by the Office of the Assistant Secretary of War in making allocation of plants and factories to branches for their production program. It includes present procedure, how allocations were handled during the World War and the relation of "allocations" to "priorities" and to "commodity" divisions.

Problem No. 15—"Progress and Requirements."

A general study of the functions of the Progress and Requirements Section, Office of the Assistant Secretary of War, and the necessity for determining progress in meeting production programs by the various agencies in the chain of procurement; how the Assistant Secretary of War and branch chief can be assured by reports that a balanced program is progressing according to schedule and what results can be predicted by reports on flow of raw materials, progress of manufacture, and the like.

Problem No. 16—"Conservation."

A study of conservation during the World War, the functions and activities of the existing Conservation Section, Office of the Assistant Secretary of War, to show how conservation of strategic and critical raw materials may be made in procurement planning, and what plans are essential for the control and curtailment of civilian consumption in another national emergency.

Problem No. 17—"Price Control in War."

A study of the economic function of price, the effect of war on prices, the causes which led to governmental control of prices in the World War, and the extent of that control, together with a discussion of the agencies employed, legal status, methods and results. The study also includes planning for price control in another national emergency.

Problem No. 18—"Personnel and Training."

A study of the policy and methods which should be followed in securing and training personnel for procurement in war and present activities in the Office of the Assistant Secretary of War in this connection. The study includes a discussion of the necessity for strict division between policies affecting military personnel and procurement personnel.

Problem No. 19—"Priorities."

A study of the World War priority agencies, why they were created, what they accomplished and their relationship to commodity, clearance and price-fixing committees. The study includes the extent to which priorities can be established in present planning to lessen the work of future priorities agencies in war and a general discussion of military and industrial priorities.

Problem No. 20—"Commodity Committees."

A problem on the organization and functions of commodity committees of the War Department and of the War Industries Board during the World War and a comparison of these with the functions and activities and set-up of the present Commodity Division of the Office of the Assistant Secretary of War.

The problem is intended to show primarily the necessity for centralizing the control of the flow of major raw materials either because of the enormous tonnage involved, as in the case of steel, or because of threatened shortage, as with manganese. Planning for centralized control is supervised by the Office of the Assistant Secretary of War. The problem develops a discussion of industrial contacts which chiefs of supply branches have through their district chiefs with outstanding industrial leaders located in War Department Procurement Districts and with the management of facilities in those districts. Very often problems viewed from only a district aspect or the point of view of an individual facility may conflict with similar problems in other districts and other facilites. Consequently the whole picture has to be coordinated with respect to raw materials and finished products by means of commodity committees.

The problem impresses upon the student the value of planning in cooperation with industry so as to gain a full knowledge of all essential war needs including vital civilian needs and balancing these against the resources of the industry. The commodity committee is the forum for discussion of requirements of all interested branches. It is, therefore, the only means of coordinating these requirements and eliminating excessive and unbalanced programs. Plans which result from their study outline a flexible distribution of the commodity which may be readily adapted to any major emergency without the necessity for a cumbersome priority system such as was necessary *without planning* in the past war. Attention is primarily focused on the relatively few subdivisions of major commodities in which shortage may be anticipated.

Problem No. 21—"Specific Procurement Plans."

An analysis of the purpose and desirable content of a plan for the procurement of a specific item or group of items.

This problem is related to matters of specifications, conservation and substitution, and to priorities.

Problem No. 22—"Measuring District Loads."

The United States is divided into fourteen War Department Procurement Districts. This is a study for the purpose of developing a usable method whereby the industrial war load on any procurement district may be measured for the purpose of comparison with the war load on other districts, to the end that the load may be distributed equitably.

Problem No. 23—"Change in Design During Production."

An historical study showing instances where changes in design during production were affected in this country and abroad during the World War and the effect of such changes on production. The study includes reasons which may compel a change in design during production and the methods that should be employed to minimize any harmful effect on production.

Problem No. 24—"Power."

A study of the power situation in the United States as it affects industrial war planning and war-time procurement. It includes present plans for the equitable distribution and coordination of power in time of war, together with a discussion of the adequacy of these plans.

Problem No. 25—"Labor."

A discussion of the adequacy of labor during the last war, of the agencies employed and methods used to meet problems which arose in connection with labor. It covers an analysis of the problem of assuring an adequate supply of labor to industry in a major war to include a discussion of probable shortage of skilled labor in the manufacture of munitions and steps that can now be taken to minimize the difficulties of the situation.

Problem No. 26—"Transportation."

An historical study of the causes which led to governmental control of transportation in the last war and the adequacy of present plans for assuring proper and sufficient transportation in a future emergency.

Problem No. 27—"Transition of Current Procurement to War Procurement in the Office of the Assistant Secretary of War."

A discussion of steps which will be necessary in transforming peace procurement activities in the Office of the Assistant Secretary of War to war procurement, both for a minor effort and a major effort, and how the necessary changes can best be made.

Problem No. 28—"Budgetary Procedure."

A general review of the War Department budgetary

procedure and comparison of same with procedure in commercial life. The study includes the extent to which present budgetary procedure would be applicable in a major emergency and the progress made in preparation of such a budget.

Problem No. 29—Review of Problems No. 14 to 20, inclusive.

This problem requires each student to show the application to the student's own branch of the subject matter of each of the following studies previously presented: Allocations, Progress and Requirements, Conservation, Price Control, Personnel and Training, Priorities, and Commodity Committees.

Problem No. 30
Problem No. 31
Problem No. 45
Problem No. 46

Resource studies respectively of Baltimore, Buffalo, St. Louis and Detroit Procurement Districts.

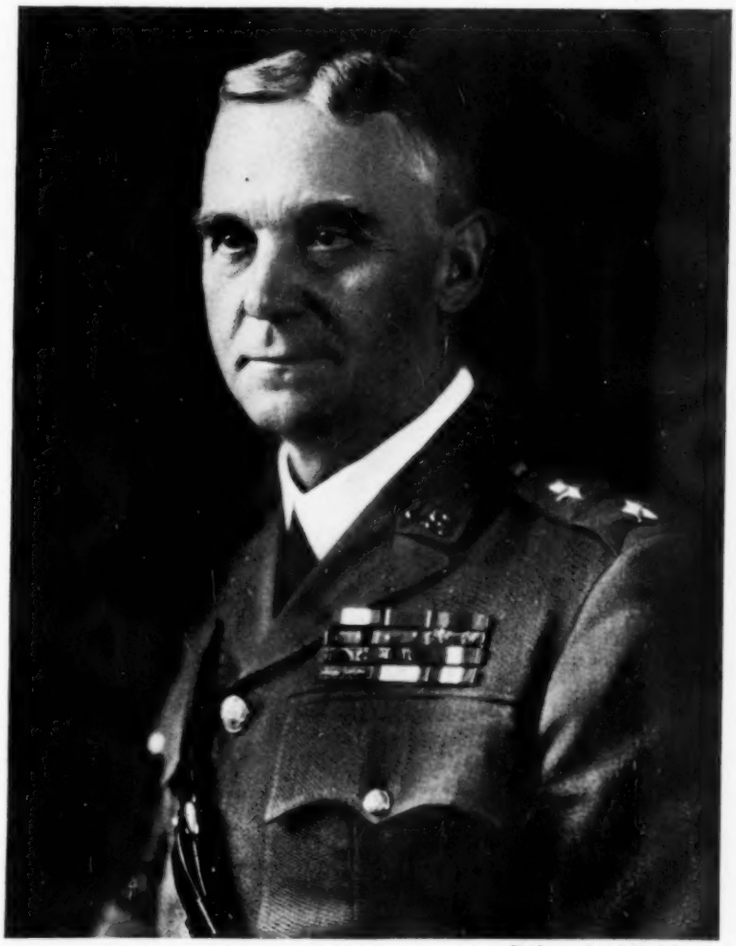
The purpose of these problems is to obtain data upon which an equitable distribution throughout the United States of our proposed "war load" may be made. The remainder of the fourteen districts will be covered in a similar manner in future courses though they have been studied previously from somewhat different angles.

The problems consist of an analysis of the industrial resources of the district to show, by industry, the percentage possessed by the district of the total capacity of the country and the trend of growth of this percentage. The problems also cover ratio of non-essential to essential productive capacity, limiting factors on expansion of productive capacity, and finally, an analysis, by industry, of the proposed war load for the district and a comparison, by industry, of the percentage of district capacity needed for its war load with the percentage of national capacity needed for the total war load.

Problem No. 32
Problem No. 39
Problem No. 40
Problem No. 42

Studies on the Industrial Mobilization respectively of Germany, Great Britain, Italy and France during the World War.

Include such phases as prior preparation, difficulties encountered and how overcome, agencies responsible for industrial mobilization and the relation of these agencies to those responsible for military operations. The problem includes a discussion of the situation during the war in raw materials, the supply of which may become a limiting factor in production, and changes in this status since that time. There is also included a discussion of the ratio of fighters to workers utilized in a maximum effort.



Underwood and Underwood.

Maj. Gen. Charles P. Summerall, Chief of Staff, U. S. A., who addressed the 1926-1927 Graduating Class of the Army Industrial College.

Problem No. 33 — "Plans for Industrial Preparedness."

To present in a readable form the essential factors entering into the War Department plans for industrial preparedness for use of persons unfamiliar with military affairs, and to show the relation of the elements of these plans to plans in commercial life for future large scale operations.

Problem No. 34 — "G. H. Q. Reserve Productive Capacity."

A discussion of the necessity for surveying, classifying and listing industrial plants that have not been allocated for war production in order to maintain a reserve for the exigencies of war such as changes in design, new types, increased load for allies, disasters to facilities, and the like.

Problem No. 35—"Legal Aspects of Procurement."

A general study of existing legal authority and restrictions which affect procurement planning and a discussion of the laws that must be repealed upon the declaration of a national emergency to permit plans for war procurement to become effective. It includes a discussion of the war powers of the President, the powers and limitations of existing legislation on the subject of commandeering, and the adequacy of present legislative plans of the Assistant Secretary of War.

Problem No. 36—"War Reserves."

A general discussion of the subject to include practicability of obtaining sufficient war reserves to make effective a definite war plan and what factors should be considered in forming a basis for proper reserves.

Problem No. 37—"The War Trade Board."

An historical study of the War Trade Board during the World War, a discussion of its origin, organization, functions and activities, relationship to other controlling agencies in this country and abroad, the means by which it obtained information necessary to its activities and the effect of its operation on the conduct and termination of the war.

Problem No. 38—"Strategic Raw Materials."

This is a general study of raw materials, the supply of which may become a limiting factor in production, to show sources of supply, principal markets, general control, trade routes, normal United States stockages, and annual United States imports and consumption. The problem includes a discussion of the agency charged with the assurance of a supply of these raw materials, how the needed flow of these materials would be determined currently, and steps that might be taken prior to and after M-Day to augment supply.

Problem No. 41
Problem No. 43 } "Study of an Industry."

These problems involve a study of two basic commercial activities, namely, the automotive and copper industries, and form part of a continuing series of such studies carried on from year to year. The purpose of these studies is to determine the relative importance of the various basic industries of the United States from the standpoint of value of product, number of wage-earners, consumption of raw materials, power, and the like, and the importance of the industry in the prosecution of a war. The effect of the World War on these industries is studied for the purpose of determining how best they may be utilized in an emergency, what curtailment or expansion would be necessary and how control over them may be exercised in war with the least harmful effect to the industry itself or to the public.

Problem No. 44—"Industrial Control Agencies in War."

An historical study of United States governmental control of industry from the Revolutionary War to and including the World War for the purpose of bringing out the reasons for and extent of such control. It includes a discussion of the extent to which our present planning, had it been completed prior to the World War, probably would have affected the scope and activities of such industrial control agencies as were set up during that period. Planning for future control agencies is also covered, as well as the effect which the magnitude of the war effort has in determining the extent of governmental control over industry.

Problem No. 47—"Evolution in Industry and in Munitions."

The purpose of this problem is to trace the historical development of warfare as far as it pertains to the character of the munitions used and to show the relationship of such development to the state of progress in industry. The problem emphasizes the importance, in procurement planning, of keeping abreast of the improvements in methods of manufacturing and of utilizing new scientific discoveries as rapidly as they are made. The fact that industrial progress is sometimes forced by the need for improved munitions of war is also brought out.

The problem calls for a comparison between the United States and other countries in regard to the amount of scientific research being carried on in industry and in munitions and a discussion of our relative strength and weakness in this regard, as far as it pertains to national defense.

Problem No. 48—"Progress Reports."

This problem is a continuation of the study begun in Problem No. 15, "Progress and Requirements," but goes into a detailed investigation of the form of progress reports on production which will be of maximum usefulness to branch chiefs and the Assistant Secretary of War. The desirability of uniform types of report, the agency responsible for the preparation of the reports, the use to be made of them and the frequency and scope of the report are discussed and definite recommendations are made.

Problem No. 49—"Factory Plans."

A study of the plans to be prepared in peace for the operation in war of plants to which war orders are now being tentatively assigned. The study includes a consideration of the type of item (commercial or special) which will require a factory plan, what agency will prepare that plan and keep it revised, the content of the plan for typical items and the use to be made of it in determining the needed flow of raw materials, process of manufacture and the like.

Problem No. 50—"Comparative War Effort of the United States."

A comparison of the war effort exerted by the United States during the World War with that of the principal foreign countries, for the purpose of throwing light on the necessity for governmental control over industry in the several nations. It also involves an estimate of what would be a maximum military effort for the United States, as measured by men under arms, if her resources were to be utilized to the same extent as those of the principal foreign countries during the war.

Problem No. 51—"Government Departments and Procurement Planning."

This problem is intended to bring out the normal functions and activities of the executive departments of the government other than Army and Navy, for the purpose of indicating what assistance each can render in solving the problem of war procurement planning and the practicability of utilizing these departments to exercise the President's war control over industry in a national emergency.

The problem stresses the importance of assistance now being rendered by the Department of Commerce in such matters as the following:

A special survey every two years for the Army and Navy of plants with a value of products of $100,000 a year and over. These plants represent over 90 per cent. of the value of products and personnel engaged in manufacture. Broadly, this survey covers 60,000 establishments, capitalizing their World War experience, thereby permitting an intelligent allocation during planning or during a national emergency. Facilities with products best

adapted or peculiar to Navy needs are being set aside for the Navy and a general reserve of facilities, available either to the Army or the Navy (depending upon the particular strategic situation) is also being established.

These special schedules will develop more fully sources of strategic materials, employees within the draft age engaged in essential manufactures, needs of facilities for power, labor, transportation and capital in order to meet war expansion, etc. The Ordnance Department has already utilized a special schedule to develop the sources of nitrocellulose, in films, patent leather, etc., so as to speed up the fabrication of strip smokeless powder.

Advantage is also being taken to adapt the regular "Census of Manufactures" schedules to procurement planning by slight modification of regular questions dealing with our critical items of supply, such as high tensile field wire, wire rope and seamless tubes.

The Bureau of Mines is handling part of the problem on strategic minerals in collecting and evaluating data on domestic and foreign sources.

Among other governmental departments rendering assistance may be mentioned the Prohibition Unit of the Treasury Department which has collected information on all alcohol plants in the United States and is keeping these data revised to date. This information is invaluable to any procurement program for smokeless powder, explosives or war gases.

These examples are a few of the many contacts already established which require analysis in this problem.

Problem No. 52—"Plant Surveys."

A study of the factors which should be kept in mind when industrial plants are surveyed for the purpose of determining their adaptability for the production of war supplies. The scope of the data to be included in the report, the agency responsible for making the survey and the use made of the report are all discussed at length.

Problem No. 53—"Production in Early Stages of War."

This problem develops the idea that the early months of war are likely to be the critical ones, because of the length of time required to develop our full industrial effort and the probable lack of adequate war reserves, and discusses the action that can be taken in peace toward speeding up production on critical items, such as artillery ammunition, in the early months of a war. In addition to our own, the experiences of Germany, France and England are studied for possible light on the subject.

The problem brings out the importance of educational orders in peace in keeping alive the art of manufacturing critical items and in assuring the maintenance of the necessary gages, special equipment and the like, which are vital to early mass production as well as the possibilities of utilizing in the early stages of war temporary or improvised facilities, not adapted to mass production, to increase output prior to the time when the main program is fully developed.

Problem No. 54—"Relation of American Industry to Foreign Commerce."

A discussion along broad lines of the dependence of important industries of the United States upon foreign commerce and the effect on those industries of the complete cutting off of all exports and imports.

Problem No. 55—"Commodity Studies."

A joint study by all students from a particular branch, of one or more of the basic raw materials which must be furnished in order that the branch may meet its production program. The items to be studied are selected by the branches themselves and the investigation includes a summation of the commercial and military requirements, a compilation of sources of supply, the trade routes followed by the commodity, the agencies which control the visible supply, the trade associations involved, the experts from civil life who can aid in procuring or distributing the commodity, the control which would have to be exercised over the commodity in war, and the like. The data obtained from these studies form the bases on which the plans for the procurement of the commodity in war are formulated.

Problem No. 56—"Individual Specific Procurement Plans."

This problem requires the preparation by each student of an actual plan for the procurement of a specific finished item needed for war. The items assigned for study are selected by the student's own branch and a copy of the report is furnished to the branch chief, hence the work done under this problem is a direct contribution to procurement planning in the supply branches.

Since these specific procurement plans are the main objective of procurement planning, to which all other studies are contributory, much emphasis is placed upon the necessity of making these plans complete and usable, of having them reviewed and approved by the industry which is to produce the item and of keeping them revised to meet developments in industry.

The scope of the various specific procurement plans differs greatly, depending upon the character of the item involved. Briefly, they consider requirements, the sources of supply and methods whereby any anticipated difficulties in procurement may be overcome.

Problem No. 57—"War Game."

This problem completes the course. It extends the idea of the orientation war game held earlier in the year to the point where the students, acting as executives in the Office of the Assistant Secretary of War, the Army and Navy Munitions Board and in the governmental agencies for control of industry, are given specific problems in regard to procurement that might arise in war and are required to present the solutions. This problem, therefore, sums up in a practical manner all the work of the year and leaves the student with a clear idea of the nature of the procurement problem and of the interrelation of the agencies involved in planning for and carrying out its solution.

Exercises at which the sixth class was graduated were held at the Army Industrial College, June 24, 1927, with Col. Hanford MacNider, Assistant Secretary of War, Maj. Gen. Chas. P. Summerall, Chief of Staff, U. S. A., and Dr. Franklin Martin, Director General of the College of American Surgeons and a member of the Advisory Board of the Army Industrial College, who served during the World War as a member of the Advisory Board, and later as Chairman, of the General Medical Board, Council of National Defense, in attendance. Col. H. B. Ferguson, C. E., U. S. A., Commandant of the College, presided.

The principal address, which follows, was made by General Summerall:

General Summerall's Address

"Though your class is the sixth to graduate from this institution, it is the first to have devoted a full free academic year to the study of the war-time problems of industry. These graduation exercises therefore constitute an especially significant occasion. They signalize the progress which has resulted in conformity with an idea to which I gladly give my sincere approbation.

"Your studies have contributed to a compilation of basic information on the industrial effort in war, comparable in value to the purely tactical literature which was formerly of main concern to military students. However, your mission in this line of endeavor is not completed. You have had the privilege of release from all other duty for a period of nine months, in order that your devotion to reflection and study on this all-important question of industry in war might prepare you for greater responsibility.

"Your attention to this question does not cease with your graduation. You have the basic facts as a groundwork. We hope and expect that you will contribute further elaboration of your ideas of this subject during the ensuing years of your military careers.

"This is an unique institution from the standpoint of old conceptions of Army schools. At our service schools for many years military art was studied mainly from the point of view of troop leadership. We thereby gained a habit through prescribing the principles upon which the eligible manhood of the country was to be organized and trained as an army. We could stipulate the basic requirements of a soldier without reference to civil requirements.

Industrial Mobilization a Study of Civil Organization

"You have had to take a different point of view during the courses here. You learned at an early stage in your studies that you could not prescribe a new machine or organization for war, but that the war-time industrial structure is no other than the peace-time industry, abridged here and expanded there, but spurred to its maximum effort on its maximum time schedule. You learned that even though the nation be at war, its industry remains in the same hands as during peace. Consequently, your studies of industrial mobilization have been a study of civil organization. Your plans had to pass the critical test of industrialists and keep step with their progress.

"Long before the clouds of the Revolutionary War took form, General Washington realized the dependence of the colonies upon foreign industry and understood the serious handicap which would be entailed by resistance to the mother country. Industry continued to be recognized as an element of our national defense but it took the World War to fully demonstrate its great importance, especially to our peace-loving nation, which has avoided a large standing army and a large investment in reserve material. Now at last we fully appreciate that a coordinated industry is essential to an army in the field and that effective mobilization is dependent upon the ability of factories to supply the needs of the Army.

Mass Production a New Factor

"Standardization, specialization, and the resulting mass production are comparatively recent developments by industry. These practices have come to dominate industry and are responsible for our world leadership in trade. Upon such an organized industry the Army must depend for its supply in an emergency. To receive full benefit we must understand the principles upon which industry is built, and aid industrial organizations in their efforts to solve our supply problems.

"The military mind is prone to interpret the term 'mass production' as an assurance of rapid munitions supply. We hear of factories which turn out so many completed automobiles every minute, and of packing houses which convert ever-moving streams of live stock into products ready for the table, but we neglect to reflect upon the days and months devoted to the planning of this production before it became almost a mechanical operation.

"With 80 per cent. of the motor cars of the world and the gasoline to operate them, with a production of over 50 per cent. of the world's steel, with the ratio of horsepower to labor the highest in the world, and, with few exceptions, having available all essential raw materials, this country should eventually exceed any probable enemy in production, provided we are not crippled before we develop our industrial potentialities. Planning in peace for the prompt and efficient use of these industrial advantages assures such early supply as should prevent our being crippled during the early months of a war, and so should make possible the mobilization of such strength as might be needed for a decisive victory.

Time the Vital Factor

"During the World War the monthly increment of soldiers sent to France was, at its maximum, about 300,000. Your future efforts will follow your studies which have pertained to reduction of the time necessary for obtaining the vital articles of equipment and supply. We are not so much concerned with eventual quantities of munitions, which will be sufficient even though no thought or effort is given to this problem prior to the actual beginning of war, provided defeat does not disrupt industry. We are concerned with reduction of the time required to start effective production.

"If you can reduce this period 30 days, the combat army is increased by 300,000. This is equivalent to giving the commander of any future army a reenforcement of 15 divisions; or, if you wish to view the problem from the other angle—if you fail to reduce the period of production by 30 days, and such reduction be possible, your failure is equivalent to the loss of 15 divisions. Therefore, your task has potentialities of the greatest import to the future safety of our nation. Your work is of prime interest and importance to all military men.

"There is another aspect to your endeavors. During the World War, 39 per cent. of our regular officers were sent to the theater of operations. Of the remaining 61 per cent., many were employed in an attempt to obtain the munitions and supplies required by our forces. These officers on this duty were not all officers of the supply branches but were drawn from the Infantry, Cavalry and Artillery. If plans are prepared, and the task broken up into clear-cut missions, all but a few regular officers can be released for the zone of combat. Any commander of an army who received an addition of a thousand regular officers would cer-

Army Industrial College, Class of 1926-1927

Left to right, first row: Maj. Henry W. Harms, A. C.; Maj. E. S. J. Irvine, C. E.; Capt. D. A. Hanes, Q. M. C.; Maj. Roy C. Heflebower, M. C.; Capt. Kenneth C. McIntosh, U. S. N.; Lt. Col. John A. Wagner, Q. M. C.; Lt. Col. W. O. Smith, Q. M. C.; Maj. Archie W. Barry, A. C.; Maj. Robt. W. Voeth, U. S. M. C.; 1st Lt. Byron A. Falk, S. C.; and Capt. E. M. Scott, Q. M. C.

Second row: Capt. Francis C. Tyng, M. C.; Maj. R. P. Howell, C. E.; Maj. John Mather, Ord. Dept.; Capt. H. McC. Yost, C. E.; Capt. Calvert H. Arnold, S. C.; Maj. Geo. Luberoff, Q. M. C.; Maj. Geo. M. Halloran, C. W. S.; Maj. Robt. H. Duenner, M. C.; Maj. Roy H. Coles, S. C.; Maj. Reiff H. Hannum, Ord. Dept.; Capt. R. J. Hernandez, Q. M. C.; and Capt. F. E. Hagen, Q. M. C.

Third row: Lt. Col. O. H. Sampson, Q. M. C.; Maj. W. Lee Hart, M. C.; Maj. E. O. Hopkins, F. D.; Maj. J. T. Harris, Q. M. C.; Maj. Donald Armstrong, Ord. Dept.; Capt. H. U. Wagner, Ord. Dept.; 1st Lt. Jas. B. Carroll, A. C.; Capt. Henry M. Black, C. W. S.; Capt. O. P. Winningstad, Ord. Dept.; Capt. Clyde H. Morgan, Ord. Dept.; 1st Lt. John Y. York, Jr., A. C.; and Capt. Read Wipprecht, Ord. Dept.

tainly extol the benefits of a plan that made this possible and practicable.

SUBSTITUTES MAY BE NECESSARY

"Notwithstanding our best attempts to foresee the future, it may be necessary, in the early days of an emergency, to bring men to the colors at a greater rate than is now contemplated. We must be ready to do this so far as it is within the bounds of possibility. We must make definite investigations in order to determine the availability of all practicable substitutes. While we cannot, of course, improvise ammunition and airplanes, we can, from the abundance of our resources, find substitutes for clothing, transportation, and many other articles.

"Research for improved weapons and improved methods of manufacture must receive persistent attention if we are to fully perform our obligations to preparedness. In your work on plans you represent the War Department, which has been charged by law with the task. As these plans touch every phase of our nation's industries, you must deal with many leaders of industry. With definite purpose and knowledge you must present to them our needs so they can prepare their plans, so their willingness to cooperate can be made effective, and so they may give us the benefit of their suggestions.

"In conclusion, I congratulate both the faculty and students upon the completion of an extremely beneficial course of instruction. I know the Army and the nation will benefit from the interest and ideas which you graduates will carry to your duties from this college. Your preparation for those duties assures you an eager welcome on your new assignments."

The officers who were graduated were:

Maj. Donald Armstrong, Ordnance Department, Katonah, N. Y.; Capt. Calvert H. Arnold, Signal Corps, Macon, Ga.; Maj. Archie W. Barry, Air Corps, Wenasoga, Miss.; Lieut. Henry M. Black, Chemical Warfare Service, Bryn Mawr, Penn.; Lieut. James B. Carroll, Air Corps, Bradford, Ill.; Maj. Roy H. Coles, Signal Corps, Warren, Ind.; Maj. Robert H. Duenner, Medical Corps, Washington, D. C.; Lieut. Byron A. Falk, Signal Corps, Minneapolis, Minn.; Capt. F. E. Hagen, Quartermaster Corps, Boulder, Colo.; Maj. George M. Halloran, Chemical Warfare Service, York, Penn.; Capt. D. A. Hanes, Quartermaster Corps, Russellville, Ky.; Maj. Reiff H. Hannum, Ordnance Department, Pottsville, Pa.; Maj. Henry W. Harms, Air Corps, South Dakota; Maj. J. T. Harris, Quartermaster Corps, Parkersburg, W. Va.; Maj. W. Lee Hart, Medical Corps, York, S. C.; Maj. Roy C. Heflebower, Medical Corps, Washington, D. C.; Capt. R. J. Hernandez, Quartermaster Corps, Brooklyn, N. Y.; Maj. E. O. Hopkins, Finance Department, Ellsworth, Kan.; Maj. R. P. Howell, Corps of Engineers, Goldsboro, N. C.; Maj. E. S. J. Irvine, Corps of Engineers, Phoenix, Ariz.; Maj. George Luberoff, Quartermaster Corps, New Orleans, La.; Lt. Comdr. K. C. McIntosh, United States Navy; Maj. John Mather, Ordnance Department, Lowell, Mass.; Lieut. Clyde H. Morgan, Ordnance Department, Cleveland, Ohio; Lt. Col. O. H. Sampson, Quartermaster Corps, San Francisco, Cal.; Capt. E. M. Scott, Quartermaster Corps, Richmond, Ind.; Lt. Col. W. O. Smith, Quartermaster Corps, Tuscon, Ariz.; Capt. Francis C. Tyng, Medical Corps, Salt Lake City, Utah; Maj. Robert W. Voeth, United States Marine Corps; Capt. Herman U. Wagner, Ordnance Department, Philadelphia, Penn.; Lt. Col. John A. Wagner, Quartermaster Corps, Asheville, N. C.; Capt. O. P. Winningstad, Ordnance Department, Berkeley, Cal.; Capt. Read Wipprecht, Ordnance Department, Bryan, Tex.; Lieut. John Y. York, Jr., Air Corps, Tenova, W. Va.; Capt. H. McC. Yost, Corps of Engineers, Massillon, Ohio.

A Standard Method for Measuring Small Arms Targets

Capt. F. J. Jervey, Ord. Res., U. S. A.*

THE problem of target measurements has been the subject of much discussion in friendly debates since the early days of competitive ammunition tests. Apparently, everyone has his own, or someone's else idea as to what should be the governing factors for determining the winner of ammunition tests, and, if he has sufficient perseverance, he eventually gets his ideas incorporated in the specifications governing these tests, even though the new thought may live but for one year.

From an historical standpoint this is indeed unfortunate, as it makes it almost impossible to draw an accurate comparison of the ammunition test records made from year to year and it does not allow a clear picture to be shown of the progress that is being made by the large cartridge manufacturers and Frankford Arsenal in the matter of perfecting the accuracy of ammunition.

For instance—In the ammunition tests held at Sea Girt in 1913 for the selection of ammunition for the International Matches, the Winchester Repeating Arms Company was victorious in the three hundred meter contest by virtue of an average mean radius of 1.761 inches for ten ten-shot targets. In 1920 the Remington Arms Company won the Olympic six hundred yard ammunition contest with an average mean radius of 3.41 inches for thirty ten-shot targets. In 1923 Remington Arms Company ammunition won the International three hundred meter contest with a *figure of merit* of 2.80593 and in 1924 this company repeated with a figure of merit of 2.179. However, in this last case, the firing range was reduced to three hundred yards. What is the comparison between a mean radius at three hundred meters, a mean radius at six hundred yards, a figure of merit at three hundred meters and a figure of merit at three hundred yards?

As no one else seems willing to bother with the small details necessary to unravel this mystery, it falls upon the Ordnance Department to compile the records of ammunition tests and show, if possible, the progress that has been made.

For the one thousand yard Palma contest, this is comparatively easy as fortunately in all but one year the winner of this test was selected from the ammunition having the smallest average mean radius. The exception to this was in 1921, in which year the Board specified in the program that "targets will be judged by the 'mean error' instead of the mean radius as formerly. The mean error is the mean of the extreme vertical deviation and the mean vertical deviation. The mean radius *may* be taken for information but in view of the slow rate of fire will not be considered in the test, etc." Thanks to some lover of history, the mean radius was recorded by the Board, thereby enabling the 1921 test to be compared with tests conducted in other years.

In 1921 the battle of mean error reached its peak and many arguments were advanced in favor of each system. These arguments were not careless expressions of opinions but rather conclusions reached after careful and lengthy studies.

The most noteworthy of these theses received by the Board came from Mr. Jarvis Williams, formerly vice-president of the Remington Arms Company, exponent of the "mean radius" system, and Maj. K. K. V. Casey, Director, Military Sales Division, E. I. du Pont de Nemours and Company, who, I believe, is the author of "mean error" system of target measurements.

In defending the mean radius system, Mr. Williams advanced the following arguments:

"With regard to the method of measurement, we have given a good deal of study to this matter during the past year and believe that the so-called 'mean error' determined upon by your Board is fundamentally wrong as a measurement of accuracy. The elimination of consideration of the horizontal dispersion of the shots prevents any weight being given to one of the most important, if not the most important characteristic of the ammunition, and one in which the rifleman is most vitally interested, namely, the wind-jamming qualities of the bullet. The principal natural causes of the dispersion of ammunition fired under uniform conditions are:

(a) Variations in velocity.
(b) Variations in whip or jump of barrel caused by variations in barrel time.
(c) Effect of wind.
(d) Mechanical inaccuracy in the construction of the bullet itself.

"Causes (a) and (b) usually result in vertical dispersion. Cause (c), the effect of the wind, usually results in horizontal dispersion, but if the wind is blowing more or less up or down the range, it also has considerable effect upon the vertical dispersion. Cause (d) is the most important one of all, in that it is most likely to produce the greatest dispersion, and dispersion from this cause may be either vertical or horizontal or a combination of both. This can be easily demonstrated mathematically, and because of the chance that an unbalanced bullet may have an absolute horizontal dispersion with no vertical dispersion, or an absolute vertical dispersion with no horizontal dispersion, or a combination of both, it seems to us that some form of target measurement should be used which takes into account this most important factor. 'Mean radius' does this; in fact, it takes into account dispersion in any direction from the center of impact, and we believe it to be the true figure of merit for the accuracy of any ammunition. Its one objection, that it takes into account horizontal dispersion by the wind, is most certainly offset by the fact that it is vitally important that the effect of the wind on a bullet be as small as possible, and, if thought advisable,

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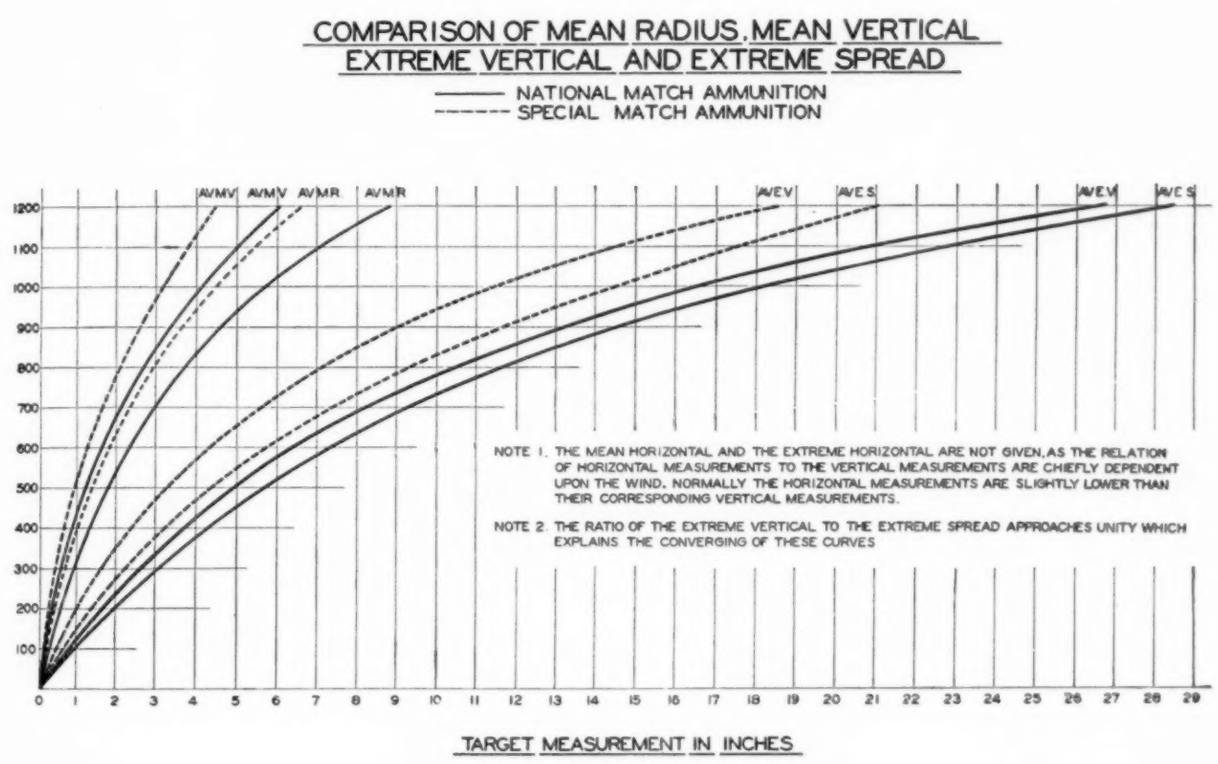
the effect of variations in the wind blowing at the time the test is made can be reduced to a minimum, as in the past, by increasing the rate of fire.

"Giving the same weight to the extreme vertical dispersion as to the mean vertical deviation, we feel is also fundamentally wrong as a measurement of accuracy in that the two extreme shots are given double the weight of the balance of the shots on the target. The figure that the rifleman is most vitally interested in, and which probably most accurately represents the real measurement of accuracy, is what is known as the 'probable error'; in other words, the probable dispersion of any individual shot from the point of aim. It can be mathematically demonstrated that the 'probable error' of any individual shot is directly proportional to the average error of a large number of shots. The average error is, of course, identical with the term 'mean radius,' which we ordinarily use, and if the 'mean radius' is directly proportional to the probable error, it follows that in itself it constitutes a system of measurement which fairly represents the comparative accuracy of various lots of ammunition tested under similar conditions."

Mr. Williams recalled a most interesting experiment performed by the Remington Arms Company in 1921 which bears out his contentions that mechanical inaccuracy in the construction of the bullet is of vital importance and most likely productive of the greatest dispersion. In this experiment bullets were purposely unbalanced by drilling a small hole in the base near one edge. By properly marking the cartridge to indicate the position of this hole and qualifying to the same position when the cartridges were inserted in the chamber of the rifle, they were able to produce a ten shot group approximately two inches in diameter at 100 yards. When, however, the cartridges were not qualified, but were put in the chamber in a "hit or miss" fashion, the shots were dispersed around the periphery of the circle approximately sixteen inches in diameter. In other words, they made a practical demonstration of the fact that it is entirely a matter of chance as to whether the dispersion from an unbalanced bullet is vertical or horizontal, or a combination of both.


COMPARISON OF MEAN RADIUS, MEAN VERTICAL
EXTREME VERTICAL AND EXTREME SPREAD
NATIONAL MATCH AMMUNITION
SPECIAL MATCH AMMUNITION
AVMV
AVMV
AVMR
AVMR
AVEV
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NOTE 1. THE MEAN HORIZONTAL AND THE EXTREME HORIZONTAL ARE NOT GIVEN, AS THE RELATION OF HORIZONTAL MEASUREMENTS TO THE VERTICAL MEASUREMENTS ARE CHIEFLY DEPENDENT UPON THE WIND. NORMALLY THE HORIZONTAL MEASUREMENTS ARE SLIGHTLY LOWER THAN THEIR CORRESPONDING VERTICAL MEASUREMENTS.
NOTE 2. THE RATIO OF THE EXTREME VERTICAL TO THE EXTREME SPREAD APPROACHES UNITY WHICH EXPLAINS THE CONVERGING OF THESE CURVES
1200
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0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
TARGET MEASUREMENT IN INCHES

Fig. 1.

A practical and technical discussion of the so-called "x and y errors" can be found in Dr. F. W. Mann's book, "The Bullet's Flight from Powder to Target" (Part 3, pages 350-358, incl.).

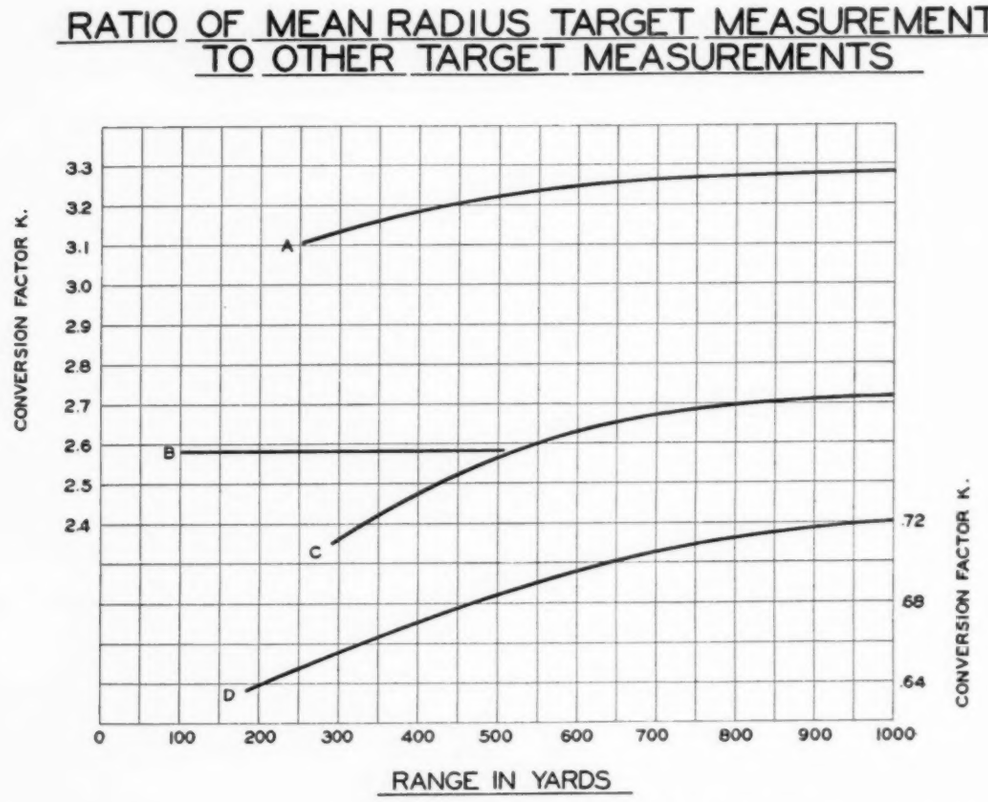
Major Casey advanced the following argument in favor of the mean error system of target measurements.

"On the subject of measurement, it has been my own observation that in long range firing, eliminating wind, the greatest expected error is the vertical; in other words that there is nothing that vertical error will not show that the horizontal error shows. As to the question of giving too much value to the extreme, I might bring out the point that it is the extreme shot that leads the rifleman astray, it usually being the case that after one shot going wild in a vertical direction, it takes the rifleman from three to five shots before he will find himself and be able to make satisfactory progress with the score. It is well enough for the manufacturer or experimenter to talk about the 'probable error' but 'probable error' does not enter in the category

of the rifleman. What interests him is actual error and that actual error occurs in the sequence of shots not from any established mean but from the center of the bull's eye. If the individual rifleman were able to place his center of impact coincident with the center of the bull's-eye, he might then consider 'probable error' but unfortunately there is no way for him to do so. It is because of the great danger to the rifleman of the uncertain elements caused by a high or low shot that has resulted in so much agitation on the desirability of using unstraightened barrels.

"On the effect of wind, I might bring out that the vertical group is influenced by variations in the wind but to a very much less extent than the horizontal, but to this extent it will show in the case of a head or rear wind the relative 'wind bucking' qualities of different types of ammunition.

"From a practical rifleman's standpoint, he gives very little consideration to the effect of head or rear winds from 600 yards down unless they are combined with other atmospheric conditions to influence elevation. But at 800, 900 and 1,000 yards the rifleman will use a 'rule of thumb' method about as follows: That a wind of a certain velocity will have one-eighth the effect on elevation for a direct head or rear wind, that a direct cross wind of the same velocity would have in a horizontal direction at 900 yards one-sixth, at 1,000 yards one-fourth. The figures given in the 'blue book' as to the effect in inches of a ten mile head and rear wind, as also the effect in inches of a ten mile cross wind will bear this out.



CURVE A RATIO AVERAGE, EXTREME SPREAD TO AVERAGE MEAN RADIUS.
CURVE B RATIO AVERAGE, FIGURE OF MERIT (MEAN OF AV. E.V. AND E.H.) TO AVERAGE MEAN RADIUS. THIS CONVERSION FACTOR IS CONSTANT FOR ALL RANGES I.E. 2.58.
CURVE C RATIO AVERAGE, EXTREME VERTICAL TO AVERAGE MEAN RADIUS.
CURVE D RATIO AVERAGE, MEAN VERTICAL TO AVERAGE MEAN RADIUS.

CURVES ARE BASED ON FIRING RECORDS OF NATIONAL AND SPECIAL MATCH AMMUNITION, 1920-1925.

EXPLANATORY NOTE.
TO OBTAIN MEAN RADIUS MEASUREMENT FROM OTHER TARGET MEASUREMENTS, DIVIDE THE KNOWN TARGET MEASUREMENT BY THE CONVERSION FACTOR "K" FOR THE GIVEN RANGE. EXAMPLE: WHAT IS THE M.R. AT 600 YARDS IF E.V. IS 8 INCHES.
FROM CURVE C "K" AT 600 YARDS = 2.64
$\therefore M.R. = \frac{E.V.}{K} = \frac{8}{2.64} = 3.03$ INCHES.

Fig. 2.

Inches Changed On Target by a Ten Mile Wind

	VI	XII	III & IX
100	0.03	0.02	.992
200	.12	.11	2.93
300	.41	.40	7.84
400	.69	.68	14.83
500	1.4	1.3	23.92
600	2.5	2.4	35.95
700	4.4	4.3	50.7
800	7.8	7.6	68.96
900	14.7	14.1	90.7
1000	25.1	23.9	115.0

"Of course the practical rifleman does not use these exact figures. The 'rule of thumb' for cross winds is practically the number of hundreds of yards multiplied by the number of miles of wind per hour, divided by ten, which then gives him the amount of correction he will use on his wind gage in one-quarter points. Any variation in either a 3 or 9 o'clock wind will be compensated for by using Captain

Zalinski's table of deviating components which are really the nearest fraction to the cosine of the angle. If a rifleman is shooting at one thousand yards and the wind is blowing ten miles an hour from 1:30 o'clock, he will, therefore, use a correction which works out miles per hour (10) multiplied by number of hundred of yards (10), equals 100, divided by 10 equals ten quarter points which applying the table of deviating components is then cut to three-quarters resulting in a wind allowance of seven quarter points or one and three-quarter points. The effect of that same wind from the same direction on elevation would be two minutes of angle cut to three-quarters or a correction of one and one-half minutes of angle. That is as far as the rifleman can apply the principles. Now to show the effect of a switch of this wind. If the wind were to switch from 1:30 to 3 o'clock, the rifleman would promptly have to increase his wind allowance by an additional three-quarters points or thirty inches, his total allowance then being 100 inches whereas were the wind to shift from 1:30 to 12 o'clock, the rifleman would make a change in his elevation of one-half minutes of angle or 5 inches, his total allowance then being twenty inches.

"When the wind switches from 1:30 to 3 o'clock compelling the rifleman to increase his wind allowance it also causes him to decrease his elevation by fifteen inches.

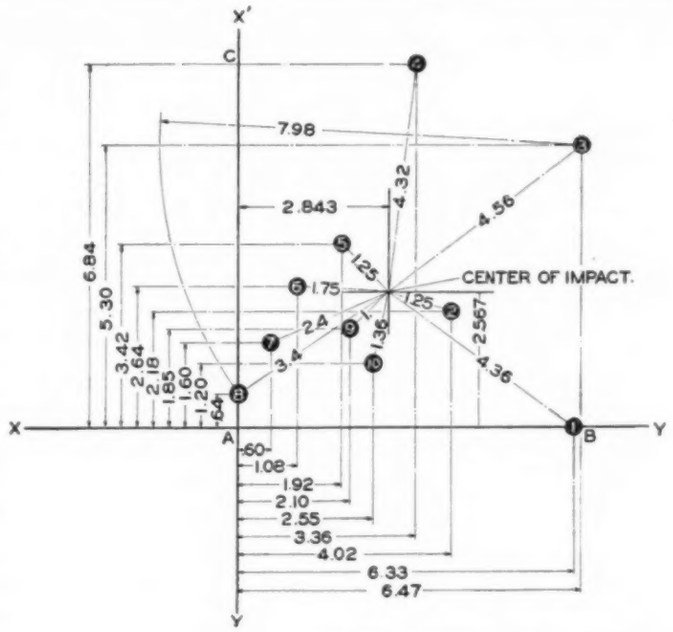
"When the wind switches from 1:30 to 12 o'clock the rifleman increases his elevation by five inches but has to decrease his wind allowance by seventy inches.

"This proves that elevation is influenced more by changes in the direction of wind between 10:30 and 7:30 or 1:30 and 4:30 than it is between 10:30 and 1:30, or 4:30 and 7:30.

"Inversely the same applies to the horizontal effect but to a much greater extent.

"Of course the figures used by the practical rifleman are only approximate as exact figures would vary with different makes of ammunition, especially in regard to their 'wind bueking' qualities. For instance, the rifleman might be able to ignore entirely the effect of a slight change of wind as far as his elevation is concerned but he could not ignore the effect of the same wind on the horizontal deviation, even assuming that the ammunition he was using had greatly superior 'wind bueking' qualities to any bullet of any ammunition developed to date. The 'wind bueking' qualities of any bullet of any ammunition are in reality a direct result of

STANDARD METHOD OF MEASURING TARGETS



MEASUREMENTS

Shot Hole	From Base Lines: Vertical	From Base Lines: Horizontal	From Center of Impact: Vertical	From Center of Impact: Horizontal	From Center of Impact: Radius
1	0.00	6.33	2.567	3.487	4.36
2	2.18	4.02	0.387	1.177	1.25
3	5.30	6.47	2.733	3.627	4.56
4	6.84	3.36	4.273	0.517	4.32
5	3.42	1.92	0.853	0.923	1.25
6	2.64	1.08	0.073	1.763	1.75
7	1.60	0.60	0.967	2.243	2.40
8	0.64	0.00	1.927	2.843	3.40
9	1.85	2.10	0.717	0.743	1.00
10	1.20	2.55	1.367	0.293	1.36
	10|25.67	10|28.43	10|15.874	10|17.616	10|25.65
	2.567	2.843	1.587	1.762	2.565

Mean Radius	= 2.565
Mean Vertical	= 1.587
Mean Horizontal	= 1.762
Extreme Ver. (AC)	= 6.840
Extreme Hor. (AB)	= 6.470
Ext. Spread-8 to 3	= 7.980
Fig. of Merit, ½ (AC + AB)	= 6.655

Fig. 3.

ACCURACY OF LONG RANGE, CALIBER .30
PALMA AND OLYMPIC MATCH AMMUNITION

Year of Test	Winner	M. R. 1000 yds.	Type of Rest
1909	U. S. Ctg. Co.	8.36	Rifle in Machine Rest
1913	U. S. Ctg. Co.	6.154	Rifle in Machine Rest
1914	Winchester	6.855	Rifle in Machine Rest
1921	Remington	6.04	Rifle in Machine Rest Mann Barrel in V Rest
1922	Western	5.69	Mann Barrel in V Rest
1924	Remington	5.497	Mann Barrel in V Rest
1925	Frankford	4.43	Mann Barrel in V Rest

TABLE I.

COMPARISON OF SHORT RANGE, CALIBER .30
INTERNATIONAL AND OLYMPIC MATCH AMMUNITION

Year of Test	Winner	Range	Figure of Merit	Mean Radius at Given Range	M. R. Com. to 300 Meters
1912	U. S. Ctg. Co.	350 meters	——	2.55"	2.00"
1913	Winchester	300 meters	——	1.761"	1.761"
1920	Remington	600 meters	——	3.41"	1.57"
1923	Remington	300 meters	2.806	——	1.09"
1924	Remington	300 yards	2.179	——	1.02"
1925	Frankford	300 meters	2.11	——	.844"

TABLE II.

the time of flight or in other words the time in which that bullet is traveling through a moving body (in this case the air), slightly compensated by inertia. This naturally throws the advantage to the heavier bullet. Other things being equal (that is if the time of flight of two bullets is identical at any certain distance) the heavier bullet will have the slight advantage over a lighter one by reason of inertia, but this advantage is shown equally well in a head or rear wind in its effects on elevations as it would be in a cross wind in its effect on wind allowance although in a lesser degree. We want to realize in selecting ammunition for the use of the rifleman that theories are all right up to a certain point but not beyond the point where the rifleman can apply those theories."

While appreciating the force of Major Casey's argument, the author is inclined to agree with Mr. Williams that vertical measurement alone will not necessarily take care of that very important error caused by mechanical inaccuracy of the bullet.

While on the subject of mean radius, it might be of interest to mention the Pan-American method of determination. A vertical line is drawn, dividing equally the number of shots on the right and left of this line. A similar, horizontal line is then drawn. The intersection of these lines is taken as the center of impact from which the mean of the distance to each shothole is computed. This method, of course, does not penalize the off shots as much as the true center of impact method.

The Kentucky Rifle describes the very unique method of measuring targets in the early part of the 18th century: "Group shooting was mostly from muzzle rest. In firing contests three to five shots were, as a rule, fired. At the conclusion of a string a wooden peg was inserted in each bullet hole and a piece of cord stretched around each peg. Later the cord was measured and the marksman with the shortest cord won. This was called 'string measure.'"

One of the methods for determining accuracy of caliber .22 ammunition is by use of a disk of given diameter for a given range. If this disk will cover all shots on the target, the target is given a score of 100. For 10 shot targets, each shot falling outside of the disk penalizes the score ten points. Thus one shot falling outside of the disk would give the ten-shot group a score of 90.

If you care to go into scientific measurement of accuracy, consider the method used by the Coast Artillery. This, however, is not so much a test of ammunition as it is the function of the gun and accuracy of the fire as regards fire control and gunnery. A pyramidal target is towed by a tugboat and the shots observed from the tug and also from a land station. The tug observes the "over" and "shorts" while the station observes the "rights" and "lefts." The shots are then plotted on a representation of a battleship with regard to angle of fall and horizontal and vertical profile of the battleship. The figure of merit is then computed from a formula which is a function of the number of hits and the time. The writer has never been an eyewitness at a coast artillery test, but the above was offered by an ex-coast artilleryman.

Table I shows the comparative accuracy of ammunition selected for the Palma and Olympic Matches from 1909 to 1925, inclusive. Tests were not held in 1926 and 1927.

In comparing these records, however, it should be remembered that the tests held up to 1921 were conducted with the rifles held in machine rests. In 1921 one-half of the program was conducted in this manner and the other half with the use of the heavy Mann barrels held in "V" rests. Since 1921 all tests have been conducted with Mann barrels.

The Mann barrel has advantages over the machine rest as it is more "fool-proof" and demands less care. However, if great care is taken with the rifle as to the way it is imbedded in the stock, particularly at the muzzle, and the way in which the rifle is placed in the machine rest, there is probably little difference in its accuracy as compared to the Mann barrels. It may be said that this was not borne out in the ammunition tests in 1921 when such a big variation was shown in the two types at the 1,000 yard range.

In analyzing this test, however, it should be remembered that the winning National Match ammunition gave an average mean radius at 1,000 yards with the machine rest of 8.62 inches as compared to 8.42 inches in the Mann barrel. Variation was very great in the Palma test of that year but this was due principally to unfavorable weather conditions. As soon as the Mann barrel test was completed and the machine rests installed, a "fish-tail" wind set in. Everyone knows what effect a wind of this type will have on a group fired at 1,000 yards. A strictly accurate comparison, therefore, cannot be drawn between the Palma records made prior to 1921 and since 1921 due to the different conditions surrounding these tests. However, it is safe to say that a steady improvement has been made each year and the 1,000 yard targets are gradually beginning to look like the old 300 meter targets.

The 300 meter records present a difficult problem to make a comparison that will be acceptable to ammunition experts, there being only one year in which the mean radius was recorded for this range. It was the concensus of opinion of the ammunition experts who shot holes on targets made by super-accurate ammunition fired at 300 meters are so closely grouped that in many cases it is nearly impossible to locate the center of impact of each of the ten shots. For this reason, the accuracy has been determined by a so-called "figure of merit" which in this case represents the mean of the average of the extreme vertical deviation and the average of the extreme horizontal deviation of all targets.

While it is granted that it is difficult in some cases to speedily locate all of the ten shots on a three hundred meter target, in the 1925 ammunition test held at Aberdeen Proving Ground, the writer saw some of the spectators attempt to "stump" the famous Mr. Harry Pope on an extremely difficult target. Two minutes observation with his pocket glass was required for the veteran gun expert to unravel the mystery. Again for the sake of history, it is believed to be a pity that the Board doesn't specify that the mean radius *may* be recorded for the three hundred meter range.

In order to present a picture of the comparative accuracies made at the 300 meter ranges, a study has been made of the records compiled from the ammunition tests conducted by the Ordnance Department from 1920 to 1925, the records previous to 1920 being too incomplete to be of material value. The curves shown in Fig. 1 were made from these records.

The mean radii for the 300 meter targets shown in Fig. 2

were computed from the curves shown in Figs. 1 and 2. As an example, in 1912 the mean radius was recorded as 2.55 inches at 350 meters. Three hundred and fifty meters is equivalent to approximately 383 yards and 328 yards is equivalent to 300 meters. Now from Fig. 1, taking the curves of average mean radius of National Match ammunition, the mean radius at 383 yards is 1.35 inches while from the same curve, the mean radius at 328 yards, or 300 meters, is 1.05 inches. Assuming the accuracy of the two types of ammunition to be proportional for the two ranges, we have—1.35 M. R. at 383 yards is to 1.05 M. R. at 328 yards as 2.55 M. R. at 383 yards is to "X" M. R. at 328 yards, or 1.35/1.05 equals 2.55/X, X equals 2.00.

In 1923 the winning ammunition gave a figure of merit of 2.806 at 300 meters. Now from Fig. 2 curve B is the ratio of the figure of merit to mean radius. From this curve, the conversion factor "K" is 2.58 at 328 yards (300 meters). The mean radius therefore equals F. M./2.58 equals 2.806/2.58 equals 1.09 inches.

It is not presumed that these curves will hold true for any given test as there are so many factors that enter into the measurements, such as the direction of the wind, the weight of the bullets, velocities and the type of rifling. The curves merely represent the average taken over a period of five years. There are times when the extreme vertical deviation has twice the magnitude of the extreme horizontal deviation and again there are times when the tables are reversed. Normally, however, the horizontal measurements lag slightly behind the vertical measurements.

Fig. 2 gives a few conversion curves for converting different known target measurements to terms of mean radii. This method affords only a quick, rough check with an approximate mean radius when there is not sufficient time to locate the center of impact and to compute the mean radius from that point.

In view of the different methods that have been used in the past in determining winning ammunition and the many misleading terms employed, it would seem highly expedient that target measurements and definitions of these measurements should be standardized.

The following is the standard method for determining mean radius and other target measurements. The equipment necessary for quick results consists of a table with a true edge, a T-square, a triangle, engineer's square, pencil, and, if convenient, an adding machine.

Place the target on the table with the vertical edge of the target parallel to the true edge of the table. This is not necessary if only the mean radius and extreme spread are desired. However, it is necessary for true horizontal and vertical measurements. Referring to Fig. 3, draw a horizontal line XY through the center of the lowest shot hole of the group.

Draw another line X′Y′ at right angles to this line, passing through the center of left hand shot hole "8." Measure the vertical height to the center of each shot hole from the horizontal line, XY and tabulate these figures under "vertical." Now measure the horizontal distance to the center of each shot from the vertical line, X′ Y′ and tabulate the results under "horizontal."

A convenient method of making these measurements, is to project these shots on the horizontal and vertical line with the aid of the T-square and triangle and then measure along the horizontal and vertical lines, the distance from the base lines to these projections. Add up the vertical measurements and divide by the total number of shots on the target. This figure represents the height of the center of impact above the base line XY (horizontal line drawn through lowest shot hole). Now lay off a horizontal line which will necessarily be parallel to XY, a distance above XY equal to this figure. Add up the horizontal measurements and divide by the total number of shots on the target. This figure represents the distance from the vertical line X′Y′ to the center of impact. Lay off a vertical line parallel to X′Y′ a distance to the right of this line equal to this figure. The intersection of this line with the horizontal line establishes the "center of impact" of the group.

Now measure the distance from the center of impact to the center of each shot hole and tabulate these under "radius." To avoid confusion and the possibility of measuring the same shot twice, it is well to start at a fixed point and measure around clock-wise or contra-clock-wise, taking each shot in order, that is, referring to Fig. 3, take 1, 2, 3, 4, etc., in order. Now find the sum of all of the radial measurements and divide this by the total number of shots on the target. This gives the *"mean radius."*

To determine the *mean vertical deviation* proceed as follows: after the center of impact is established, measure the perpendicular distance of the center of each shot hole to the horizontal line drawn through the center of impact. Add these figures and divide by the total number of shots.

To determine the *mean horizontal deviation* proceed as follows: after the center of impact is established, measure the perpendicular distance of the center of each shot hole to the vertical line drawn through the center of impact. Add these figures and divide by the total number of shots.

To determine the *extreme spread* by trial, locate the two shots that are farthest apart and measure from center of shot hole to center of shot hole.

To determine the *extreme vertical* deviation, measure the vertical distance from the horizontal line XY to the center of the highest shot hole on the target.

To determine the *extreme horizontal* deviation, measure the horizontal distance from the center of the farthest shot hole to the right to the vertical line X′Y′.

To determine the so-called *figure of merit,* add the extreme vertical deviation to the extreme horizontal deviation and divide by two.

With one exception these measurements tell the complete story of the target. What is the minimum circle into which all shots will group? In cases where all shots fall within a circle whose diameter is the extreme spread, this is easily found as it equals the extreme spread. In cases where some of the shots fall outside of this circle, the problem of accurately determining the minimum group may become very complex and can only be quickly approximated by resorting to the cut and trial method.

In conclusion, it is hoped that in the future, regardless of what characteristics are to decide the winning ammunition, that the mean radius, extreme spread, extreme vertical, extreme horizontal, mean vertical and mean horizontal measurements will be determined and recorded in order that accurate records may be kept and handed down to posterity.

Ordnance News in Pictures

Tank Wrecked in Explosives Tests

This obsolete tank was used recently in tests conducted at the Army Tank School, Camp Meade, Md., to determine the effect of certain high explosives on the huge steel monster.

Ruins of Powder Magazine After Explosion at Cracow, Poland

A portion of the powder depot at Mitowice, near Cracow, was demolished recently by a series of explosions of unknown origin. Photo shows the smouldering remains of one of the magazines.

University Students Study Ordnance Aboard Ship

Supplementing their course in naval science and tactics, Harvard freshmen are shown here studying the mechanics of a breech block aboard the U. S. S. FLORIDA *during a 15-day training cruise.*

Progress in the Standardization of Ordnance Specifications

Maj. C. A. Walker, Ord. Dept., U. S. A.

ONE of the important parts of the War Department's plans for industrial preparedness is the preparation of adequate standard specifications. In fact this work is so important that it might well be considered a vital part of these plans. The large volume of munitions required in an emergency and the quantity production necessary to obtain these munitions cannot be secured until proper specifications are available and if these are not prepared during peace along with the other plans, then there will be a delay until the deficit is remedied. I do not mean by this that limited manufacture cannot be started until our so-called standard specifications are available but I do mean that quantity production undertaken without them will result in delays, confusion and misunderstandings. This was certainly the case at the beginning of the last war and no reason is seen for believing conditions would be different at the beginning of another war.

It is the belief of most people engaged on this work that not only must specifications be available but also that they must be in the standard form. By this I mean they must be standard specifications in the sense which I will later describe. The Director of the Bureau of Standards who is also Chairman of the Federal Specifications Board, in his 1923 report, stated in reference to the importance of this work, "One of the most important phases of standardization from the purchaser's point of view is standardization of specifications. It is the most essential step in the economy which results from the purchase of materials or supplies in large quantities and is a necessary factor in the improvement of quality of materials and the adaptation of quality to definite uses." Since this standard specification is considered so important it might be well at this point to define it or more properly to describe it.

Standard Specification Defined

A standard specification is one fulfilling two conditions. First it must have been prepared according to the form prescribed for all Government specifications. This requirement is entirely one of arrangement of subject matter. A specification considered by itself may fulfill its purpose and answer all needs without complying with this requirement. However, I believe that second thought will convince you that it would be a better specification for Governmental purposes if it did conform in this respect. Our system of writing specifications requires a reference to all other specifications which must be complied with in the manufacture of the article in question. Thus a specification for a complete round of ammunition may, and would, refer to a number of other specifications covering the component parts, and these in turn may refer to still others and so on in some cases until you get back to raw materials. Consider how confusing it would be to a manufacturer if the subject matter of all these specifications was prepared in a different manner, then consider how it simplifies matters if the same numbered paragraph in each specification covers the same subject matter, and you can appreciate the importance of this form. When this form has been used a manufacturer can refer to any specification in the shortest possible time and obtain the desired information with the least delay and confusion. There is enough red tape to be unwound in placing a contract even under the most favorable conditions and we certainly would not be justified in attempting to use specifications all different in the arrangement of the subject matter. Most of you have seen this form at some time or other but many probably have not stopped to consider that it is the standard form prescribed for all Government specifications. I am therefore going to go over it and point out some of the salient features. The form has eight main headings as follows:

I. GENERAL SPECIFICATIONS.
II. TYPES, GRADES, CLASSES, ETC. (as applicable).
III. MATERIAL AND WORKMANSHIP, ETC.
IV. GENERAL REQUIREMENTS.
V. DETAIL REQUIREMENTS.
VI. METHOD OF INSPECTION, TESTS, ETC.
VII. PACKING AND MARKING.
VIII. NOTES.

Each one of these main paragraphs contains information essential to a good specification and this information is arranged in an orderly and logical sequence. For instance, paragraph I (GENERAL SPECIFICATIONS) lists all general specifications which must be considered and at once gives an index to the documents to which reference must be made in order to obtain a complete understanding of the specification. Paragraph VI (METHOD OF INSPECTION, TESTS, ETC.) states all the tests to which the article must be subjected to determine if it meets the requirements of the specification. It states the methods of making the tests and in fact gives all the information regarding inspection and tests that a manufacturer must have in order to determine if his product is satisfactory. As stated earlier a close adherence to this form enables one familiar with it to locate at once any pertinent information desired. The order placing it in effect directs not only that the arrangement of subject matter be followed but also prescribes the data which will be placed in each paragraph and the method of numbering paragraphs and sub-paragraphs. This form has undergone many changes and revisions before its final approval and it is certainly a great improvement over the former somewhat haphazard method of arranging a specification. Additional changes may be found necessary in the future but in its present shape it seems to fulfill its purpose to the satisfaction of most people concerned.

The other requirement of the standard specification is not so easily defined nor so readily accomplished. It is

by far the more important of the two requirements and is the one which causes the greater part of the delay involved in writing specifications. Stated in its simplest form this requirement is that the subject matter of all specifications must be brought into conformity with standard commercial practice. It is usually a long and difficult job to determine just what is the standard commercial practice pertaining to any particular article. Frequently it happens that no commercial standards have been established or different practices are followed by different manufacturers of equal standing in a trade. One manufacturer will state that a certain specification is sound and will present no difficulties in manufacture. Another will say that it is all wrong and it would be impossible to manufacture under it. In such cases the best that can be done is for the people responsible for the specification to be guided by the preponderance of opinion or to use their best judgment. A compromise between the two opposing views is sometimes possible but usually results in a specification that is more or less unsatisfactory to every one concerned.

Progress in Standardization

The above briefly outlines what constitutes a standard specification. I will now try and give you an idea of the progress made in this standardization work. Specifications in one form or another are as old as the art of manufacture but specifications in the form we know today came into use only in comparatively modern times. However, as far back as the time of the Roman Empire, standardization was recognized as a necessary adjunct to quantity production. It had been the custom of the Romans to adopt the best weapons of their conquered foes and, as a result, they soon found themselves with a variety of weapons which greatly complicated their problem of manufacture and supply. To meet this difficulty standard weapons were adopted about 100 B. C. which permitted quantity production and greatly simplified the supply of their armies.

Immediately prior to the World War considerable progress had been made in commercial life in standardization of articles manufactured and in specifications. A very familiar example of this standardization is the electric light socket in every day use. We would be placed to great inconvenience if every manufacturer of electric sockets made a different kind. Another familiar example is the standardization of the railroads. Without this standardization we would have to change cars every time our journey required us to travel over more than one road. As it is we can travel across the continent without leaving the car we started out in. In fact the majority of the comforts and conveniences which we enjoy are a direct result of standardization and without this standardization we would find our daily routine greatly complicated, and the cost of most articles in every day use beyond the reach of our pocketbooks.

The Government, however, had done little to follow this commercial lead. Our steel specifications for instance were not in conformity with commercial practice, although commercial steels would have answered our purpose and could have been obtained much cheaper. Our drawings called for many special articles where a standard commercial article would have done equally well. The Government could obtain these articles in the limited quantities needed but it had to pay a very high price for them. When we actually entered the War, however, things were entirely changed. The Government became the largest purchaser in the country and it soon became evident that we could not buy what we needed in the quantities required with the specifications available. Consequently new specifications had to be written and while this was being done, many delays and misunderstandings occurred, which could have been avoided if proper specifications had been available in the beginning. These specifications, hurriedly prepared as they were, while an improvement over the former ones, were by no means perfect or satisfactory. Government specifications before the war not only did not conform to commercial practice but also specifications prepared by different departments for the same articles were not in harmony. Consolidated purchasing under these conditions was difficult if not impossible and this lack of uniformity had to be remedied.

The Federal Specifications Board

In order to insure that specifications conform to commercial standards and to properly coordinate specifications between the different departments of the Government, several agencies have been established and provision made for contact with the standardization bodies in the commercial world. One of these agencies, the Federal Specifications Board, was organized under the provisions of Circular No. 42, Bureau of the Budget, October 10, 1921. Applicable extracts of this Circular, as given in Army Regulations 850-25, cover the organization and functions of the Federal Specifications Board and are considered so necessary to a proper understanding of our specification work that I will quote them in full.

"1. For purposes of coordination and economy in the procurement of materials used by the Government under specifications prepared in the various branches thereof, to avoid duplication of effort and for the better utilization of resources and effort, there is hereby established the Federal Specifications Board.

"2. It shall be the duty of the Federal Specifications Board to compile and adopt standard specifications for materials in the services and to bring specifications into harmony with the best commercial products wherever conditions permit, bearing in mind the desirability of broadening the field of supply.

"3. The head of each department and establishment purchasing materials for services in accordance with specifications prepared in such departments shall designate one representative to serve as a member of the Federal Specifications Board and shall designate such assistants to such member as may be deemed necessary, and notify the Chief Coordinator for General Supply of their selection.

"4. The specifications that are prepared, adopted by the Federal Specifications Board, and approved by the Director of the Bureau of Standards, shall, as far as practicable, be binding upon and govern all departments, bureaus, agencies, and offices of the Government. In the event of disagreement in specifications or methods of procedure the case will be submitted to the Chief Coordinator for General Supply, whose decision shall be final as to the action taken, subject only to appeal by the head of the department concerned to the Director of the Budget."

The War Department representative on the Federal Specifications Board is detailed from the Supply Division, General Staff.

From the above it is seen that the Federal Specifications Board has a very important responsibility in the preparation of Government specifications and the degree of satisfactoriness of these specifications will depend primarily upon the way this responsibility is met. In order to perform this work the Board has organized a number of technical committees, composed of representatives from all interested branches of the Government, whose duty it is to prepare and submit to it specifications for promulgation as master specifications. Each committee covers a certain class of materials. For instance, the Metals Committee prepares specifications for metals and metal products, and is made up of representatives of the different branches of the Government interested in this class of supplies. These committees are in turn divided into sub-committees which actually do the work of preparing the specifications. The procedure in operation is about as follows.

A branch of the Government has need for a certain specification and submits a request to the Federal Board. The Board determines if such a specification should be prepared and if so refers the request to the committee charged with the work of preparing this class of specifications. The committee then refers it to the proper one of the sub-committees, if one exists, and if not, organizes such a sub-committee. The sub-committee prepares a tentative specification and submits it to the main committee at one of its regular meetings. Copies are distributed to all members of the committee and one month is allowed in which to comment thereon. Such comments as are received are considered by the sub-committee and the specification is revised if such action is deemed advisable. The specification after revision is presented at the next meeting of the main committee and if no objections are offered, is referred to such technical societies as are interested in the specification, for comment and criticism. Such comments as are received are sent to the original sub-committee which after due consideration makes the necessary changes and resubmits the specification to the main committee for final action. If approved by the main committee it is sent to the Federal Board, which refers it to all interested branches for comment. If no adverse comments are received it is adopted by that Board, approved by the Director of the Bureau of Standards and issued as a master Federal specification. Its provisions are then binding on all Government procuring agencies.

War Department Specifications

Specifications prepared in this manner, called Master U. S. Government Specifications, are not used by the War Department for procurement purposes but as a basis for the preparation of War Department specifications. War Department specifications must be prepared in accordance with the standard form and must conform as to technical requirements to the Federal specifications. The Federal Specifications Board does not concern itself with specifications for purely military articles or articles required by only one branch of the Government. For the purpose of more definitely defining the responsibility of each branch, the War Department has divided its requirements for specifications into classes, assigned numbers thereto and assigned the classes to the various branches for the preparation of specifications. As an example, Class 57 "Metals, ferrous and non-ferrous and products thereof not otherwise assigned," pertains to the Ordnance Department and that department is responsible for the preparation of all necessary specifications.

Procedure

Questions relating to the procedure followed in preparing a War Department specification and in obtaining its approval are frequently asked, so a brief description of this process as it is followed in the Ordnance Department is given, although it is fully covered in Army Regulations 850-25. Each division of the Manufacturing Service has prepared a list of specifications which it considers must be written. This list or the proper part of it is furnished one of the manufacturing arsenals equipped to manufacture that particular class of articles. The manufacturing arsenals prepare practically all of our specifications except those for steel which are prepared by the Ordnance Department Metallurgical Board. The arsenal prepares a specification, checking it to see if it conforms to the technical requirements of any pertinent Federal specification and any simplified practice recommendation accepted by the War Department. The specification is then sent to the proper division of the Manufacturing Service which, after checking, forwards it to the Specifications Unit. This Unit maintains a master file of all specifications and when one is received, checks it to see if it is prepared in accordance with the standard form above described and submits it to the Ordnance Department Specification Board of Review, which must determine if the article covered can be obtained in an emergency in the quantities required without undue delay or cost, if the article is practical of manufacture and where strategic raw materials are involved, obtains the concurrence of the proper Commodity Committee of the War Department. After return from this Board, the specification goes to the Technical Staff and is submitted to one of its sub-committees. This sub-committee acts on the specification and returns it to the Specification Unit to obtain clearance for procurement from the Assistant Secretary of War. After this clearance it is presented at one of the meetings of the Ordnance Department Technical Committee and the concurrence of all interested branches of the War Department is obtained. Once each month the Specifications Unit submits a report to the Adjutant General of all specifications which have been through the above described process and he approves them for insertion in the War Department Specification Index. The specification after this approval is ready for printing and distribution.

The total number of specifications estimated as required by the Ordnance Department is 1,440. This is only an estimate and may be considerably in error. If it is in error I believe the estimate is too low. The total number approved and available as of December 31, 1926, was 447, approximately 30 per cent. The progress appears slow but the situation is not as bad as this percentage might lead one to believe. The specifications already prepared include those for all the more important items of Ordnance equipment and while it is desirable to have standard specifications for the remaining items, the Department could, it is believed, function in an emergency without them.

Trophies for American Riflemen

With the approach of the National Rifle Matches, which will be held at Camp Perry, Ohio, in September, interest is renewed in the great number of prizes awarded successful contestants. On this and the following pages are reproduced trophies presented by the Army Ordnance Association and several of its members for proficiency in rifle shooting.

THE ARMY ORDNANCE TROPHY

Presented by the Army Ordnance Association to the Winner of the President's Match, National Rifle Matches

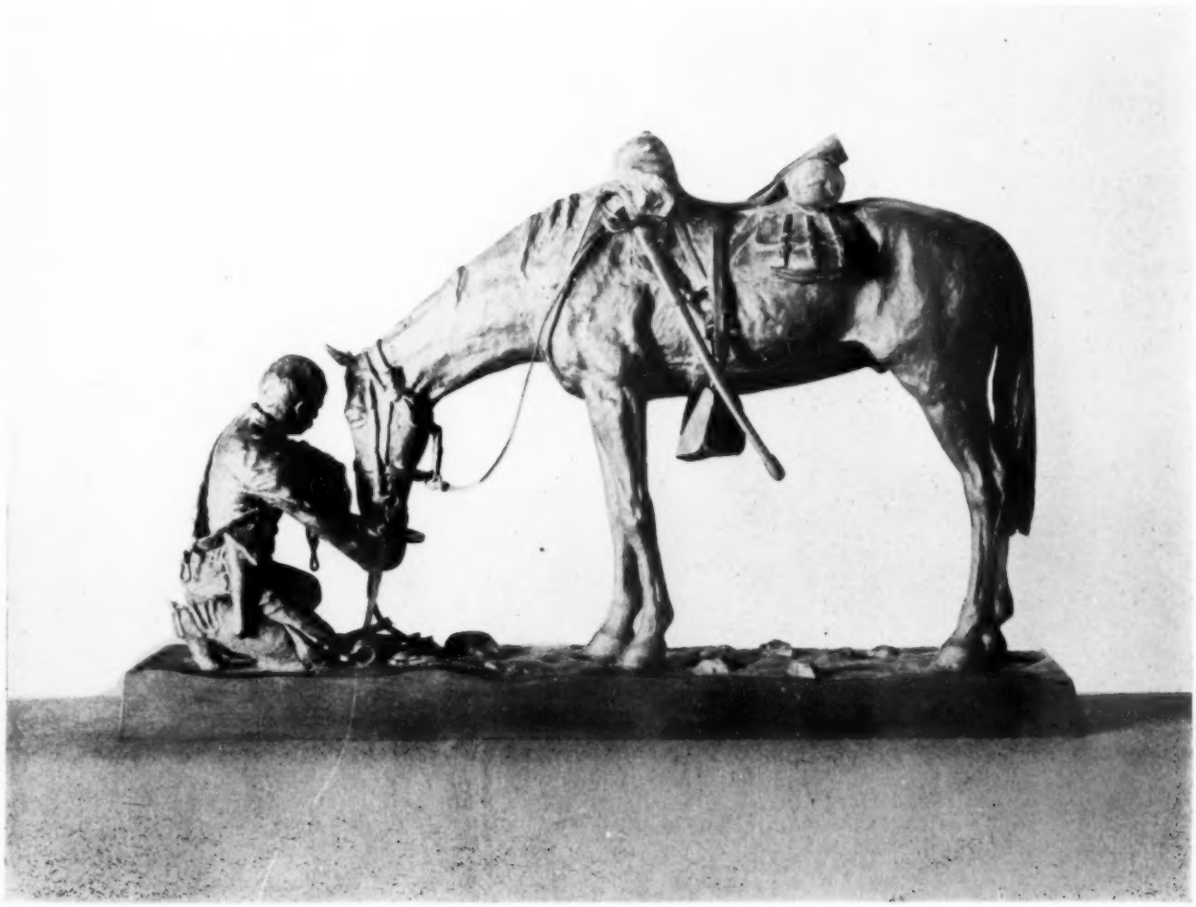
The Army Ordnance trophy, presented to the winner of the President's Match, is a special Springfield rifle, caliber .30, sport model. The President's Match is open to any citizen of the United States, the service rifle and sight being used. The course consists of 10 shots at 200 yards standing, 10 at 600 yards prone, and 20 at 1,000 yards prone. The Army Ordnance trophy is the only trophy with the exception of badges, medals, cash prizes, etc., which becomes the property of the winner, all other trophy awards remaining in the custody of the winner until the National Matches are again held. This trophy, manufactured at the Springfield Armory, represents the highest art in rifle construction.

THE ARMY ORDNANCE R. O. T. C. TROPHY

Awarded by the Army Ordnance Association

This trophy, a U. S. rifle, caliber .22 Ml, is a special rifle awarded by the Army Ordnance Association to the R. O. T. C. student of any recognized unit who, during the scholastic year, attains the highest score in competitive matches arranged by the Director of Civilian Marksmanship.

The Crowell Trophy



"The Last Drop"

Presented by Hon. Benedict Crowell, of Cleveland, Ohio, President, Army Ordnance Association. Awarded to the Winner of the Crowell Match, the 1,000-Yard Stage of the Palma Individual Match

Charles Schreyvogel, sculptor of "The Last Drop," is well known for his paintings of western life. He received gold medals at the Paris Exposition, 1900; Buffalo, 1901; and St. Louis, 1904. His best known works, in addition to "The Last Drop," are "My Bunkie," the picture of a trooper dragging his wounded comrade on to the crupper of his mount in midstream while under fire; "How-Kola," the picture of a wounded Indian pleading for water; and the historical painting, "General Custer Before His Last Fight."

The Lee O. Wright Trophy

"The Rising Sun"

Presented by Maj. K. K. V. Casey, of Wilmington, Del. Awarded to the Winner of the Wright Memorial Match, the 800-Yard Stage of the Palma Individual Match

"The Rising Sun" is the work of Adolph Alexander Weinman, sculptor of the statue of Lincoln erected at Hodgenville, Ky., and other notable works including "The Destiny of the Red Man" and "Kansas" at the St. Louis Exposition, and the Maryland Union Soldiers and Sailors Monument at Baltimore.

This trophy was presented in memory of Maj. Lee O. Wright, Ord. Dept., U. S. A., who, until his untimely death, February, 1925, was one of the nation's recognized authorities on small arms and automatic weapons.

The Scott Trophy

"The Bronco Twister"

Presented by Col. Frank A. Scott, Ord. Res., U. S. A., of Cleveland, Ohio, Director, Army Ordnance Association. Awarded to the Winner of the Scott Match, the 900-Yard Stage of the Palma Individual Match

"The Bronco Twister" is the work of J. Clinton Shepherd, who studied art at the Chicago Art Institute and has specialized on western subjects. His principal works, in addition to "The Bronco Twister," are "The Cayuse" and "The Maverick."

The Maintenance of Armament

Part I

Maj. R. W. Pinger, Ord. Dept., U. S. A.*

IN a political sense, the word "armament" is frequently used to cover a very broad field. Fortifications, battleships, arsenals, navy yards and mine defenses are all grouped together under that inclusive term. In fact practically every material requirement for a nation's defense or offense is embraced, with the possible exception of food, shelter, clothing and transportation. For the purpose of this discussion, however, a much narrower definition is necessary. While much of his data and many of his conclusions might apply to corresponding naval matériel, the writer must in modesty confine himself to the problem of the Army. Modern warfare has made even this one problem an exceedingly broad one. To avoid superficial treatment of a large number of related subjects, the writer has decided to speak of armament in its narrowest sense—the projectile and the essential instrumentalities for its discharge and control.

Considering the fact that the projectile alone has any destructive effect on an enemy, it is strange that so little interest, relatively, is exhibited by the public in this component of armament. Superficially it would seem far easier for the great powers to limit themselves to the possession of a definite number of projectiles of a certain caliber, than to bother with the complicated apportionment of guns, ships, bases and so on. In fact the ballistic limitations of projectiles are such that, excepting calibers less than 75 millimeters, a nation's armament strength could apparently be measured in tons of projectiles, without specifying size or type.

However the trouble with such a simple plan is that projectiles are relatively easy to manufacture and guns correspondingly difficult. Once at war no agreement as to a stock of projectiles would hold and other things being equal the advantage would soon pass to the nation best equipped with guns. Notwithstanding, therefore, the theoretical importance of projectile, the writer must attach primary significance to the instrument for its discharge, or what is popularly known as the gun.

Military writers usually refer to the arms carried by the individual soldier, the rifle, pistol and revolver, as small arms. This term is frequently used to include even machine guns. All other projectile-discharging devices are termed artillery. Of the latter, those of relatively high velocity are termed guns, those of relatively low ones mortars, and intermediate ones, howitzers. Technically these terms include only the tube or barrel part of the device, the remaining portion being called a carriage or mount. This separation of terminology is the result of production methods, the problem in the case of the barrel being a totally different one from that of the carriage.

Artillery is still further divided into fixed and mobile types. This is really a tactical differentiation, the fixed armament being the primary weapon of the Coast Artillery and the mobile of the Field Artillery, in the United States Army. However constantly changing conditions produce more or less overlapping as indicated by the assignment of railway, antiaircraft and heavy mobile ma-

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(*U. S. Signal Corps Photo*)

Personnel of Mobile Ordnance Repair Shop at work, Forty-second Division, LaCheppe, France, July 4, 1918.

tériel to the Coast Artillery, sometimes as an accessory to harbor defense and sometimes not. With these definitions in mind, the writer proposes to take up the first important element in his subject, namely the maintenance of fixed artillery.

In discussing the maintenance of fixed artillery it is necessary to distinguish between two separate phases of the problem. These might well be termed the prevention of obsolescence and the prevention of deterioration; or employing the nomenclature of the service, simply alteration and repair. Strange to say the first element is frequently the costlier and thus warrants the more detailed treatment.

When a manufacturer purchases a lathe he carefully investigates the market and finally buys the machine which in his opinion will do his particular kind of work with the greatest efficiency and lowest cost, all things considered. After purchase he does not expect to modify the tool at frequent intervals to keep it abreast of the latest improvements. Usually he intends to give it reasonable care, and at the end of ten years or so, replace it by a later model. The time may come when a similar policy will govern the Army with reference to certain classes of artillery, as is already the case with small arms. Large numbers of guns and carriages are now in relatively permanent storage, and the least modification of them would involve excessive cost, out of all proportion to the actual mechanical operations concerned. To ignore them and apply alterations only to the more accessible ones in the hands of troops would involve great and intolerable future confusion. The only practicable method is to accumulate modifications for five or six years and then, at considerable but justifiable expense, make one job of bringing the articles up to date. After two or more such extensive programs it will probably become necessary to provide for complete though not necessarily simultaneous replacement.

In the case of *fixed artillery*, however, such a policy can never be applied. Sixteen-inch guns and mounts are built in such small quantities that it takes years to develop the detailed service requirements. Building a pilot model may assist greatly in working out the production problems, but it seldom affects the design from a service standpoint, for the reason that fabrication of remaining components of the program is usually started before sufficient time has been allowed for the development of practical service criticism. It thus happens that no sooner is a piece of heavy artillery turned over to troops, than a series of modifications is instituted which continues practically throughout the entire service life of the matériel.

The performance of alteration work is complicated by several factors not frequently found in civil undertakings of a similar nature. They are briefly—

(a) The long period required for fabrication of necessary parts, special tools and fixtures, and their shipment to the point of use.

(b) The great distance between many points of use and the central authority, involving great loss of time when technical questions arise.

(c) The continual shifting of personnel including those concerned with the design, maintenance and use of matériel.

(d) The probability of new developments being made partially or wholly destroying the military value of the proposed modification.

(e) The necessity for avoiding the placing of any considerable proportion of armament "out of commission" at any one time.

(f) The uncertainty of continuity in the availability of funds.

For example, many of the major alterations require special fixtures of which, for financial reasons, but one set can be made. This set must be successively used in the various coast defenses of the United States and then shipped in turn to Panama, Hawaii and finally the Philippines. In shipment parts of this set are frequently lost or broken, involving additional delay. Sometimes they even require modification themselves, to take care of individual differences in the castings or forgings of the matériel to be altered, not anticipated by the designer of the fixtures.

Again an increase in the range and power of foreign naval artillery may make it utterly immaterial whether a certain 14-inch gun has an elevation of fifteen degrees or twenty. Or a disarmament conference may cancel a shipment of ammunition for the use of which new range scales have been ordered applied to certain guns; this would of course necessitate remodification to the earlier status.

All of these factors demand that a great deal of bookkeeping work be done if the operations themselves are to be accomplished at the least expense and with a minimum of friction and delay. Enthusiasm and energy are valuable virtues here as elsewhere, but they will not undo the harm wrought by a drawing of the wrong revision date, or mollify the exasperation of a coast defense commander when he finds that a tactically indispensable battery has been temporarily dismantled prior to the discovery of the absence of an essential part required for a prescribed alteration. In other words, records assume such importance that at least a brief discussion of them is considered profitable.

While perhaps less frequently consulted than some of the others, the most basic armament record is that which includes the important data with respect to a single *type* of gun and carriage. For example there should be a folder entitled "14-inch Disappearing Matériel—General" and another "14-inch Turret Matériel." This record might for convenience be collectively called the General Matériel Record. Data filed in each folder should include at least the following—

(a) A location list of each gun and carriage by serial number.

(b) A copy of each important piece of correspondence affecting all matériel of the type concerned.

(c) A complete bibliography of the type concerned. This is most essential as the data on the more complicated pieces of ordnance are frequently scattered among a great many Ordnance pamphlets, War Department documents, range tables, price lists, and so on, to say

A Mobile Ordnance Repair Shop ready for service.

nothing of drawings, specifications and special bulletins of various kinds.

For the reasons stated above, seacoast guns are highly individual articles. The record most often referred to might therefore be called the Individual Matériel Record or simply the Matériel Record. For each gun and carriage this should consist of a similar folder containing the following data—

(a) The original inspection and acceptance records.

(b) The original proof-firing records.

(c) Elevation table upon which range scale graduations are based. This table is of course a function of the height of site of the gun and therefore differs for each unit.

(d) Data in connection with original installation.

(e) A continuous tabulation of each series of shots fired, with references to target practice reports concerned.

(f) Numerical and graphical star-gage records showing erosion or fouling at various stages in the gun's life.

(g) A continuous tabulation of all work orders covering the alterations or important repairs performed.

(h) Copies of important correspondence referring specifically to the gun and carriage, especially that reporting accidents, malfunctions and similar occurrences.

In other words a folder of this kind is designed to become a continuous history of an individual piece of artillery throughout its service life. Bearing in mind the constant personnel changes, the value of such a history can hardly be exaggerated.

Item (g) above implies that the details of the various alterations and repairs ultimately become so voluminous that only a tabulation or register of the corresponding work orders can possibly be included in the matériel folder. It is therefore necessary to have a third set of folders called the Work Order Record. The latter consists of a folder for each main work order containing at least the following data—

(a) A copy of the work order.

(b) A copy of each drawing if there are but one or two; otherwise the list customarily included in text of the work order is sufficient.

(c) Copies of periodical reports showing status of the necessary material and funds, as well as the actual progress of the work.

(d) Copies of proof-firing report if the work has been such as to necessitate test firings.

(e) Copies or extracts from all correspondence relating to the work. These are especially necessary as the usual correspondence files cannot be depended upon for the accurate assemblage of data relating to a particular job.

It might be explained here that a main work order is only issued for an operation of some magnitude. Minor repairs are covered by "local" or "memorandum" work orders drawn against a main work order couched in such terms as—

"Maintain 3-inch (15 pdr.) Gun Matériel (16 units) in Coast Defenses of .....; no job exceeding $10.00 to be undertaken without permission from the Department Ordnance Officer."

Copies of the local work orders are then filed in the main work order folder so that the details of maintenance may be studied at any time.

In merely describing a system of records one always runs the risk of making even a simple mechanism appear quite formidable. As records invariably increase overhead, the intelligent reader is not always convinced of their utility and demands a concrete illustration of their use. In succeeding paragraphs the writer will therefore describe an actual alteration—one which on account of its bearing upon the recent disarmament conference should be of more than usual interest to anyone interested in the defense of the Philippine Islands. For convenience, this operation will be entitled "The increase of Range of 14-inch Disappearing Guns Defending Manila Bay."

The erection of these four one-gun batteries on two of

Light Mobile Ordnance Repair Shops in action.

the smaller islands in Manila Bay was completed as follows—

Batteries Greer and Crofton, February, 1916.

Battery Woodruff, March, 1917.

Battery Gillespie, June, 1918.

The work was attended by extreme difficulty as the islands are merely small steep mountain peaks thrust several hundred feet out of the water. With inadequate transportation and docking facilities, getting these guns (the "barrel" portion alone weighs approximately seventy tons) into position very much resembled the building of the pyramids. However, long before the last bolt was tightened and the last bearing fitted, criticism of their short range had become articulate. Then came the Great War which translated this criticism into action. By letter of revision dated May 28, 1917, the Chief of Ordnance directed these guns to be altered from a status of five degrees depression and fifteen degrees elevation to one of zero depression and twenty degrees elevation, thereby increasing the range by approximately four thousand yards. When it is realized that even such a moderate increase would enable artillery of this type to engage an enemy at least four minutes earlier than otherwise, the importance of the modification can hardly be overestimated. To be sure the advantage could be gained only at the expense of a correspondingly increased dead-space contiguous to the batteries, but as there were older and smaller guns suitable for covering this area, the end justified the means.

But with the German fleet effectively bottled up in its home ports and the defense of the Philippine Islands overshadowed by the much greater problem in France, not very much happened for about a year. In May, 1918, the Ordnance Officer of the Philippine Department finally received the necessary drawings and instructions and issued his work orders directing the Coast Defense Ordnance Officer (a temporary officer) to proceed with the work upon arrival of the necessary parts.

But therein lay the rub. The new elevating arms, bands and slides were huge steel castings which not every arsenal or civilian manufacturing plant could make. Orders for some parts and for the special tools and fixtures were given to the Watertown Arsenal, and most of the remainder to the Allis-Chalmers Manufacturing Company. Shipment was necessarily made by commercial steamship from the Atlantic Coast to Hawaii, and thence by Army transport to Manila. At any rate, not until August, 1918, were the principal articles actually received at Manila. In the meantime of course the war was over, temporary officers were being discharged and a general readjustment was taking place which produced conditions not conducive to effective work.

With the parts actually on hand it then became evident that certain final machining operations were impossible with the equipment on hand in the coast defense ordnance machine shop. A 48-inch planer with a long bed seemed indispensable and this in turn demanded an extension of the existing building. By the time these things became accomplished facts it was October, 1920. Even at this late date the planer had to be driven by a borrowed motor and power supplied from a nearby fortification power plant. Work on Battery Greer was actually commenced in August, 1920, but not finished until October, 1921, the delay being due to a combination of the following causes—

(a) Machinists' lack of previous experience in work of similar character.

(b) Poor transportation facilities, especially between machine shop and dock at Fort Mills, and between dock and emplacement at Fort Frank.

(c) Frequent power interruptions due to power plant being overloaded.

(d) Replacement of enlisted assistance by civilian mechanics, on account of target practice and other forms of military instruction.

At Battery Woodruff, certain parts of the work were started about September, 1920, but there being but one set of special tools and fixtures, and it being tactically inadvisable to de-commission more than one battery at a time, real progress was not initiated until a year later.

After that time the work was prosecuted with vigor and as a result the battery was ready for proof firing by April, 1922.

The same armament machinist who had successively worked out all problems at the first two batteries was then assigned to handling the work at Batteries Crofton and Gillespie, completing the former in November, 1922, and the latter in September, 1923. In the case of Gillespie delay again occurred due to target practice (November to February in the Philippines) and to the necessity for repairs to the scow used for the transportation of the heavier parts. Still the progress attained showed the wisdom of permitting one man to specialize on the job until all batteries had been completed.

It is hoped that the above recital has served its purpose by showing the time over which a single modification may extend, and as a corollary, the necessity for accurate records in order that the work might be intelligently continued. During this period the Department Ordnance Officer, the Armament Officer and the Coast Defense Ordnance Officer were changed at least twice due to the law forbidding the assignment of commissioned officers to duty in the Philippines for a period exceeding two years. Fortunately many of the civilian employes concerned remained more or less constantly at their respective tasks throughout the greater part of the time, thus providing for the continuity of interest and responsibility without which no mere system of records can possibly succeed.

Of course not all alterations are as important or difficult as the one just described. Sometimes it is merely the addition of a grease or oil cup to a minor bearing, or the installation of a stop-bolt to insure the proper functioning of a pawl. Still, although the actual work is insignificant, the modification is frequently the result of a serious accident in some far distant coast defense. Failure to carry it through with minimum delay may result in repetition of the same consequences.

The problem of prevention of deterioration, or repair, although associated with that of alteration in practice, is of a different order. The factors affecting it are:

(a) Status: that is whether in actual daily use by troops, in the hands of a few troop caretakers, or whether under the control of an ordnance field service organization.

(b) Training and skill of those in immediate charge.

(c) Climatic conditions, especially those of temperature and humidity.

(d) Location. Obviously a low lying beach battery presents conditions differing from those of one on a high mountain site.

Factor (a) would seem to be of small importance, as expensive matériel is supposed to be cared for with a high standard regardless of the temporary tactical status thereof. However as in many other cases, principle and practice differ. It is believed that, in general, armament in daily use for drill and target practice fares better than when merely maintained out of service by enlisted caretakers. To be sure the constant crashing of breech blocks produces appreciable wear in the block-carrier bearings; the constant scrubbing and polishing with a view to making the gun a thing of beauty tends to obliterate some of the original clearances and tolerances; screw and nut heads show the effect of frequent adjustment. But a personal element enters and more than compensates for these disadvantages. A battery commander if up to the usual professional standard, takes an interest in the guns he commands quite unlike the more common relationships between man and matter. Only an artillery or ordnance officer can really appreciate this attitude as immortalized by Kipling in the little ballad "Screw-guns."

As a result, it is not often that a defect of any importance escapes the watchfulness of a good battery commander or emplacement officer. Let the least cloudiness appear to dim the dazzle of the rifling, and a dozen men are heaving on the long bore-sponge. Let there be the least unusual resistance in the traversing mechanism, off come the dust and manhole covers and every square inch of roller, roller path and pintle surfaces is carefully scrutinized and the offending bit of concrete or cotton waste removed. Then just before target practice comes a most careful inspection. The recoil cylinders are drained, cleaned and refilled; new gaskets and packings replace worn ones. Frequently the whole gun and carriage is scraped to the metal and every stressed element carefully examined for cracks or flaws before the new paint is put on. For the battery personnel realizes that for pressures, energies and velocities used, few mechanisms approach the modern heavy gun in potentialities for danger. Not only battery pride but the individual sense of self protection helps to make this work a most serious undertaking.

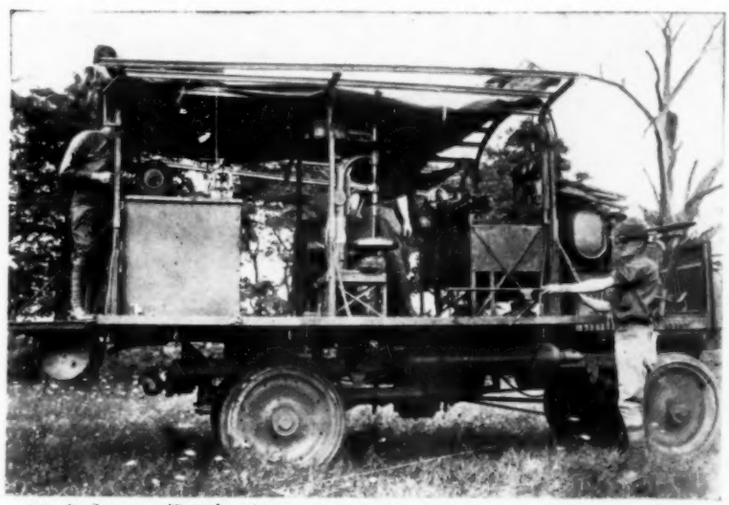
From still another standpoint the care of armament by a regularly constituted tactical organization is advantageous—that of cost. In peace time it is next to impossible for the Ordnance Department to secure funds adequate to care for both modification and maintenance. Its labor is largely civilian, the salaries of which must be charged directly to the specific job in hand. This necessitates close budgeting and the deferring of work requiring large outlay, in favor of that needing but little. On the other hand troops are paid from a general appropriation called "Pay of the Army" regardless of the exact activity in which they may be engaged. If fifty or a hundred men are needed for the efficient handling of some particularly laborious job, military training is simply suspended for a few days and all effort concentrated on the one item until it is completed.

Of course there is no question but what this system is frequently carried too far, resulting in lowered military efficiency. A well trained gun crew can fire a 14-inch disappearing gun about once in each fifty seconds. If through constant interruption of training this rate decreases to once in one hundred seconds, all elements of first cost, depreciation and so on, involved in the nation's investment is doubled. In battle the thing that counts is "hits per gun per minute" and every other question must be subordinate thereto.

Frequently too there are jobs which experience has shown should never avoidably be undertaken by troops. Hardly a battery exists where some well-intentioned sergeant has not wondered what became of the cross-hairs

after he had most carefully cleaned the inside of a complicated telescopic sight or position finder. Many an expensive special wrench has been broken in the attempt to screw a left-handed thread the wrong but customary direction. Here is where close cooperation between the armament (Ordnance) officer and the troops officer pays dividends. The combination of the technical skill and experience of the former with the control of man-power of the latter can easily save the tax payers many, many dollars.

The routine maintenance of armament by small detachments of enlisted caretakers is a method little to be commended. It is usually adopted only in the last stage of armament existence — the period immediately preceding "scrapping." Since 1916 the number of troops assigned to fixed harbor defenses has been greatly diminished in order to provide for railway, heavy mobile and antiaircraft artillery, to say nothing of entirely new arms such as the Air Corps and Chemical Warfare Services. It has therefore been the policy to man only the most important and modern armament, leaving all other to small groups of soldiers under the general supervision of a line officer. About all that is attempted is to prevent rust through the liberal use of paint and heavy oils. Once per year, or oftener where possible, each gun is retracted ("exercised" in military parlance) and allowed to go "into battery," to make sure of the proper functioning of the recoil mechanism. Sights, range finders and other delicate mechanisms are frequently concentrated where they can be under the care of a specially trained optical mechanic.



An Ordnance Repair Shop on Wheels—One of the Vehicles of an Ordnance Maintenance Company.

The care of armament by Ordnance Department personnel is usually confined to the following circumstances:

(a) Where armament has been withdrawn from troop responsibility for the purpose of making a major alteration or repair.

(b) Where new armament is being installed but where there is delay due to non-arrival of essential components, or to non-completion of the proof firing which always precedes transference to troops.

(c) Where armament is held in reserve for the use of non-active components of the regular army, national guard, organized reserves and so forth.

In the case of (a) and (b) the Ordnance Department is very careful so far as real condition of matériel is concerned. Troops are exceedingly critical of scratches, bruises, rust spots and burred threads on armament turned over to them for use. They expect however to repaint, polish brass and remove grease surplus themselves; hence any great effort along these more superficial lines while matériel is in Ordnance hands is largely wasted. This is the time, though, for most thorough Ordnance inspection, the checking of clearances and other dimensions, the star-gaging of bores and so forth. These things can be worked in with the main job with little additional expense and without the confusion and interruption involved where performed while armament is "on the manning table." Many minor defects may be discovered and repairs made at this time, which might only be brought to light a year or two later at actual target practice or possibly even in action. After all this has been done, proof firing under the deliberate and measured conditions seldom attainable in target practice acts as a complete check on everything and instils the confidence in the gun which is a most necessary element in the battery's morale.

Referring to the training and ability of those in immediate charge it is obvious that the professional ability of the men in immediate charge of armament is a most important factor in increasing the efficiency and decreasing the cost of armament maintenance. This is true of the problem of modification as well as routine repair, of the men performing the work as well as the officers directing it. In fact the question is of such importance that it might be well to dwell for a moment on some of the conditions which complicate the matter in a manner seldom encountered in civil life.

The personnel connected with armament in an insular defense like that of Manila Bay (Philippine Islands) is composed of four classes, each with its own peculiar problems:

(a) Commissioned Ordnance and Artillery officers.

(b) Enlisted men of Ordnance and Artillery.

(c) White civilians.

(d) Native civilians.

To these may now be added a fifth class—native enlisted men of Ordnance and Artillery, for in the past few years the policy has been to reduce American soldiers in the Islands to the very minimum.

Based on medical experience covering a long period of years, the law limits an officer's service in the Philippine Islands to two years, except that the officer himself may apply for an extension of one year. Upon arrival, there is always a period of adjustment to environment of not less than three months; just before return a short recuperative vacation in the cooler climate of China or Japan is frequently attempted. As a result, the time of effective service is usually too short to master all the

factors in the problem. Frequently the officer filled with "States pep" essays to do just that thing in his first few months of tropical residence. Not until he returns from the hospital is he willing to accept the advice of the "old-timers" to "gear himself down a bit." And so it is that unless the records are almost perfect, and he an inveterate searcher of them, he is not likely to know that the left crosshead rack on tactical No. 2 at Battery Grubbs was broken in firing last year, and is now held on by four countersunk screws of doubtful safety pending the arrival of a new rack from the United States. When the next transport brings ten five-horsepower pneumatic motors for installation as auxiliary projectile hoists at El Fraile, he is greatly annoyed to find that those who initiated the shipment have long since returned to the United States and evidently made no provision whatsoever for securing the very substantial air supply required, or for getting the air into the turrets when the pivots of same are already hopelessly crowded with voice tubes, gas ejection air pipes, and almost forty different kinds of electric circuits. In general he considers his two years well spent if he has "cleaned up" the inheritance left him by his predecessor and left his own so that it means anything to his successor.

With the enlisted man, the problem is somewhat different. His is no task of following through a long continuity of action, but rather the accomplishment of some definite short task. The real difficulty is in inducing men of the desired qualifications to enlist in the Army and to retain them after they have received technical training valued outside. Several years ago an attempt was made to teach every soldier a civilian trade; this largely failed because of the lack of the necessary appropriations, and because after all a man usually joins the Army "to see the world" and in the hope for excitement, rather than with an idea of increasing his later earning capacity. As a result both the Ordnance Department and the Coast Artillery Corps have had to establish excellent trade schools of their own in which their enlisted specialists are trained. However even by confining such training to reenlisted men who are likely to remain in the Army permanently, it is difficult to retain them in competition with the demand for skilled men in civil life.

These conditions have resulted in the more or less anomalous presence of civilians, not only in the office of the Armament Officer, but actually at work in the defenses themselves. In the United States no problem is involved because these men reside in nearby towns, going to and from their work like any other citizens. Their positions being permanent and well paid, no difficulty is usually experienced in securing the services of thoroughly competent men. While officers and soldiers come and go, the armament foremen and machinists stay year after year, thus automatically providing a continuity of knowledge of the particular armament concerned which might otherwise depend on records alone.

However, in places like the Philippine Islands these desirable conditions cannot be attained. It is usually necessary to induce men similarly employed in the United States to go out under a two year contract at a 20 per cent. increase in pay. Salaries and traveling expenses must be borne by the allotment in Manila, making turnover costs very appreciable. Although residing at the various military posts, living conditions, especially for men with families, are not satisfactory. The same is true of social ones for the men are neither officers nor enlisted men, the only two kinds of status for which military administration seems to provide. As a result, relative permanence of civilian assistance can be obtained only by two methods—the employment of local white mechanics or that of native labor.

In the Philippines there is still a constantly diminishing group of white mechanics who came out a decade or two ago and for one reason or another have remained. In many cases men of this class have acquired native wives. Usually they have had some years of military service and thus fit in well with the personnel with whom they work. They understand natives and can therefore be temporarily assisted by local labor at low cost and considerable efficiency. While sometimes a little lacking in energy and perhaps even prone to "look on the wine when it is red" they are almost invariably excellent all-around mechanics of the old school, not so frequently found in these days of greater specialization. In employing them the government signs no contracts and promises no free return to the United States, so expense is saved in those directions.

The development of the trade school idea in Manila is gradually producing a large class of trained native workmen of all kinds. These men can be employed for approximately one-third the pay of the white workmen. They prize the prestige associated with a government job and where properly supervised do excellent work. With a large "barrio" such as houses perhaps 15,000 natives on Corregidor Island, living conditions offer no problem for the employing officer. The only difficulty comes in the fact that no matter how efficient they may become from a technical standpoint, they can never be assisted by white soldiers. So in the past it has usually been cheaper to use highly paid white workmen assisted by white soldiers than to use less expensive brown workmen with still cheaper brown laborers. However, as the Philippinization of the Artillery and Ordnance approaches that of the Infantry and Cavalry, this difficulty will disappear.

(To Be Continued)

Ordnance of Bygone Days

Old Guns and Old New York

This old view of New York Harbor from Bedloe's Island is interesting in that it shows the type of cannon once mounted on the island and the type of contour then the pride of the metropolis. As the skyline developed so did the guns. Today both are changed somewhat!

An Influence in American History

A battery of 200 pounders as used during the American Civil War against Fort Sumter. Note the type of gun mount, sans recuperator, sans concrete, sans much of anything.

Turning Back the Pages of History

This photograph from the album of a Civil War photographer shows two 8-inch Parrot Rifles, big guns of the Rebellion days.

Small Arms Troubles Encountered in the Field

Lieut. Seth Wiard, Ord. Res., U. S. A.*

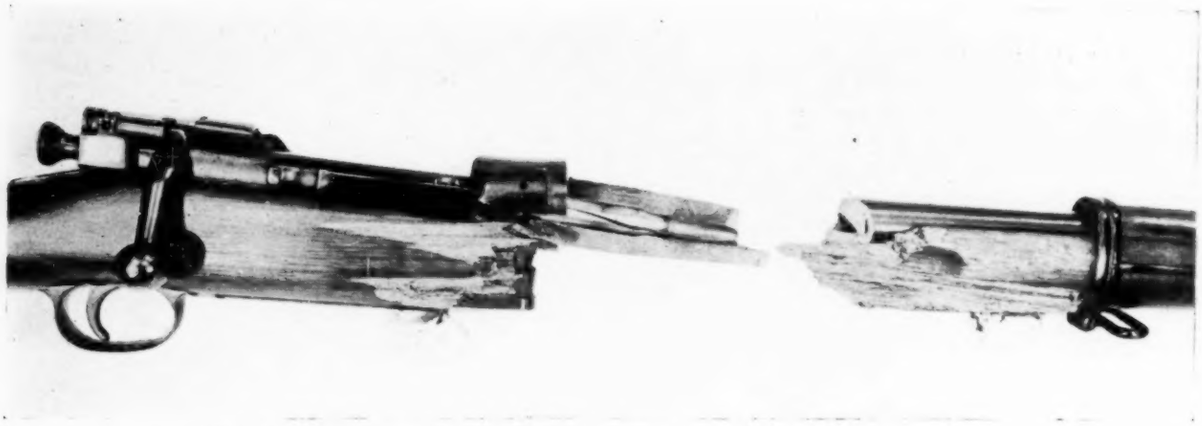


Fig. 1. The result of firing ammunition with greater than normal pressure.

THE loss of confidence in one's weapon is a powerful factor in undermining the morale of a soldier, and a field Ordnance officer, charged with the task of determining causes for various troubles, which may be encountered in connection with small arms and small arms ammunition, should be able to make a prompt determination of the causes of such trouble, and the proper explanation thereof, to remove any doubts which may surround the question of the efficiency and safety of matériel involved.

It is safe to say that the major part of the troops in an emergency army, raised from the civilian population and sent to the front after a few months of intensive training, are usually without any knowledge concerning their particular weapons, aside from what may have been imparted to them at the training camps. When such men encounter trouble with their rifles, pistols and revolvers, or the ammunition for these three weapons, it is highly essential that the causes for such accidents be thoroughly explained, and the proper remedial steps taken to prevent a recurrence. The weapons considered in this article will be primarily those of the infantryman, as they are not only found in the largest quantity, but in the cases of trouble with the larger arms, such troubles often result from causes other than will be referred to here.

Ruptured rifle and pistol barrels doubtless make up the largest amount of small arms casualties which may be encountered. Such bursts are usually caused by obstructions in the bore, and such obstructions will practically always result in a rupture of the barrel, at any point from the muzzle down to within eight to ten inches of the breech or the receiver.

Many riflemen do not realize that a plugged or obstructed barrel will burst, in most instances, when the rifle is fired. A small amount of snow, which might be scooped up by the muzzle, a small quantity of mud or dirt, loosely packed in the barrel, offers enough inertia so that pressures beyond the breaking point of the barrel are produced. It is true that it is impracticable for a man to look through the barrel frequently, but it is within the bounds of reason to expect that due care be observed in protecting the muzzle from the entrance of foreign materials. Small twigs of a diameter less than the bore, if not unduly long, will not usually cause damage to the barrel, nor will a light object such as a leaf, pieces of string and the like, but it is needless to make such differentiations to raw troops. The assumption should be taken and preached that any obstructions in the bore will be accompanied by damage to the arm.

Occasionally, cases will be found where the burst is of a more serious nature when the rear section of the barrel in the vicinity of the receiver or the bolt is involved. These ruptures can be laid, if the barrel alone is considered, to either defective ammunition or defective barrel material. If caused by defective ammunition, it is usually due to excessive pressures developed upon firing. The correction of these troubles is outside the scope of an Ordnance officer, with the exception that upon his finding that this is the source of the trouble, all ammunition of the particular lot should be withdrawn from service and segregated. At times this may be a move which will call for much acrimonious discussion and comment. If there are any cartridges in a certain lot which show unmistakable signs of high pressure, to the extent that guns are being ruptured, the entire lot is doubtless inoculated with defective rounds, and such a lot remains a constant source of danger until its destruction, or at least removal from the hands of troops.

High pressure ammunition, when sufficiently above the normal strength to cause a rupture of the barrel, has a more or less local effect. Either the forward end of the receiver will split open and the chamber portion of the barrel will be broken out, or else the barrel itself will break just ahead of the receiver. A typical illustration of such a condition is shown in Fig. 1.

The present service rifles, Model 1903, bearing serial

*Lieut. Wiard is associated with the Remington Arms Co.

numbers above 800,000, have a method of heat treatment which varied considerably from rifles under this number, and are expected to be able to withstand much higher pressures than the older arms; but in case of a national emergency, arms of all serial numbers, may be distributed generally. The rifles bearing the lower numbers are perfectly safe to use with normal ammunition, the only difference being a lower safety factor than those of later issue.

Another distinguishing mark of high pressure will be found from indications on the cartridge case itself. If the head of the fired cartridge, which will doubtless remain in the damaged rifle, is examined, it will usually bear an appearance as if it had been smoothed and ironed to some extent. The head stampings which indicate the manufacturing origin of the cartridge and the year of loading, will be partially obliterated. In many cases, the face of the primer will be quite flat and have a similar ironed-out appearance. If the breeching up of the rifle or the head space conditions, as they are termed, are proper, the rear of the cartridge case itself usually will not be ruptured, but there will always be a slight flowing or working of the metal, due to the excessive pressures generated in the case.

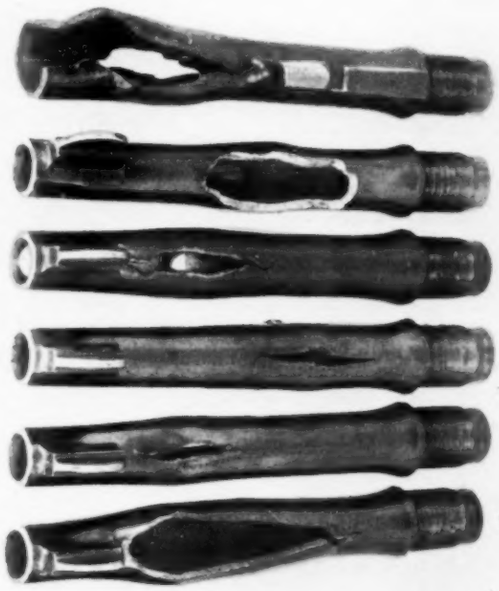


Fig. 2. Revolver barrels ruptured by shot with bullet from first shot still in the barrel.

One other main type of damage which can occur to a service rifle, is due to what is known as excess head space conditions. In other words, the distance between the face of the breech block, or bolt face, and a certain point in the chamber, which the shoulder of the cartridge beds upon, is too great. This condition is not usually found unless there is some metallurgical weakness in the locking lugs of the bolt, producing a progressive setback, although rifles which have been fired many thousand rounds or have been constantly using ammunition of higher pressures than are standard, will show signs of increasing head space. When a rifle bursts, due to excessive head space, the damage is usually from the receiver rearward. What actually happens is this: upon firing, the cartridge case sets back a trifle, possibly not more than fifteen thousandths of an inch, and the brass case being unsupported, the pressure is applied against the thinner portion of the walls of the case, and effects a tearing away of the case at this point. These very hot, high velocity gases then rush out around the bolt to the rear and their energy is such, due to their pressure and temperature, that the receiver may be split or spread, or damage to the bolt itself will follow. Any damage, of course, is usually accompanied by partial destruction of the stock, and splinters may fly into the shooter's eyes. If perchance the bolt gives away, then there is actual danger of the shooter being killed. A more or less positive identification of this trouble will be found by examining the condition of the receiver, and by examining the cartridge case, which invariably will be torn. A cartridge of normal pressure characteristics, when fired in a rifle having excessive head space, represents a potential danger. It is not believed that under such conditions it will be found necessary to recheck the head space by gaging many of the rifles in the particular organization involved, as such occurrences are quite rare, but prompt and accurate determination of the cause of this particular condition will be of great assistance in eliminating fear on the part of the soldiers.

There is one feature to be considered, however, in connection with the trouble referred to as excess head space. If it is possible, during an undue period of excitement, the bolt of a rifle would be opened on a cartridge which gave a hangfire, especially during rapid firing, and if the bolt handle were raised to the vertical position and the cartridge then exploded, the locking lugs would be cleared of their seats and the full force of the cartridge would be expended in driving the bolt to the rear. This bolt would then probably be driven entirely out of the receiver into the shooter's face, and it is problematical whether or not the cartridge case would follow the bolt, or whether the head would merely tear off under the previously referred conditions of the case being partially unsupported. The Ordnance officer making an investigation of a burst rifle under these conditions, should ascertain carefully whether or not rapid firing was being followed, in order to definitely ascertain if such a condition had occurred. A soldier might also open his bolt on

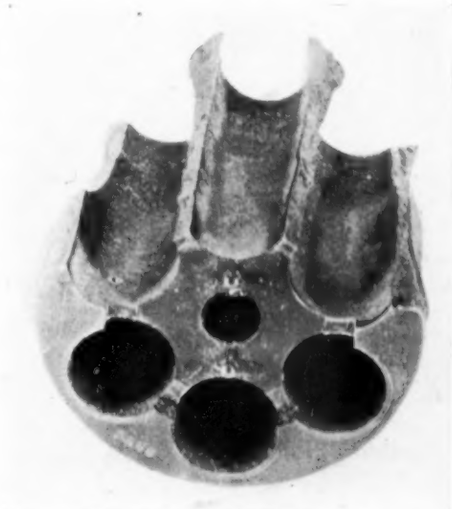


Fig. 3. Revolver cylinder burst by high pressure ammunition.

what he thought was a misfire, if he had not been thoroughly instructed previously that in the case of a misfire, the cocking piece should be pulled back. Unfortunately, this is impossible to do with a Model 1917 service rifle, and in that case the best policy to follow is to wait five or more seconds before ejecting the loaded unfired ammunition.

Casualties to pistols and revolvers themselves usually consist of a rupture of the barrel due to an obstruction which may be either snow, mud or dirt, or sometimes may be found to be the fault of a preceding shot, which had not passed entirely through the bore. In the case of the revolver there is always a gas leak between the cylinder and the barrel, and the escaping of this gas is, of course, accompanied by a certain amount of noise, which under normal conditions is masked by the regular report heard when the bullet leaves the muzzle. It is possible, however, for a soldier during the excitement of firing to have a cartridge which may be defective in some way, and which only has enough power to drive the bullet up into the barrel a certain distance. He will feel a certain amount of shock or recoil, and will hear a certain amount of noise, due to the escape of gas between the cylinder and the barrel.

Fig. 4. Effect on revolver after firing ammunition of too great pressure.

Revolver shooting is uncertain enough under conditions of combat, so that missing the target will not be wondered at, and one will assume that the bullet merely went wide of its mark. Upon pulling the trigger for the succeeding shot, if there is a bullet in the barrel, the barrel will immediately be ruptured. Fig. 2 shows several typical cases of barrels ruptured from this cause. Sometimes the bullets will stay in the barrel, but there are times when the barrel will have burst and will be empty.

Service revolver ammunition is issued with the primer and mouth of the shell protected by a water-proof compound, which should preclude the possibility of oil seeping in through the primer pocket or around the mouth of the shell and deadening the powder charge, but it is always possible of course that some slip-up may have been encountered, and a certain amount of ammunition might reach the field, the water-proof and oil-proof qualities of which would not be all that are desired. If such ammunition were carried habitually in a gun, coated heavily with oil to prevent rust, there would be, in due time, a seepage of this oil into the cartridge case, and the powder charge would be affected. Upon firing such cartridges very likely the bullet would have only enough force to go part way down the barrel and stick. This same condition would be found in automatic pistol barrels, where the barrel is ruptured either by an obstruction or by the lodgment of a bullet in the bore.

If the ammunition itself is defective, giving unduly high pressures, the action upon the gun will be either to swell or burst the cylinder, usually the latter. High pressure ammunition will burst a cylinder as shown in Fig. 3, and the gun may assume the appearance shown in Fig. 4. These cases are very rare and self-evident and, where encountered, the particular lot of pistol and revolver ammunition should be immediately segregated.

It may be of interest to know of an equally easy and sure way of removing obstructions from rifle barrels, unless such obstructions, of course, consist of a combination of cleaning rods, rags, etc., which can only be removed by the Ordnance Maintenance Company. If a bullet lodges in the bore, due to a defective cartridge, such as one with a reduced powder charge or one wherein the powder has become partially deadened, under normal conditions it is practically impossible to remove such an obstruction in the field, owing to the lack of cleaning rods of the requisite length, etc. However, if a loaded cartridge is secured and the bullet extracted, either being bent out or the neck of the case pounded with the tang of a bayonet until the crimp is loosened up, and the bullet then withdrawn, after inserting a small amount of chewed up paper into the neck of the cartridge case, which should contain its usual powder charge, minus the bullet, the firing of such a round of quasi-blank ammunition will result in building up enough pressure in the bore to blow out the obstruction. This method of removing obstructions will not bulge or ring the barrel to the slightest degree, and provides the only suitable method for solving such difficulties on the spot.

Ruptured small arms, due to various ammunition defects, do not constitute a serious menace, owing to the rigid inspection insisted upon by the Ordnance Department at the plants loading such ammunition, but where the production of this type of ammunition runs up in the millions of rounds per day, and the major part of the personnel involved in its manufacture is but hastily trained, various types of troubles are often possible, and the encountering of the result of such troubles in the field will cause a great amount of concern. Happily, this can be lessened to a marked degree if the underlying principles of the various types of gun and pistol casualties are understood and explained to the individuals concerned.

"To maintain peace in the future it is necessary to be prepared for war. There can scarcely be a possible chance of a conflict, such as the last one, occurring among our own people again; but growing as we are in population, wealth and military power, we may become the envy of nations which led us in all these particulars a few years ago; and unless we are prepared for it we may be in danger of a combined movement being some day made to crush us out."
—Gen. U. S. Grant.

The Sand Test as Applied to High Explosives and Their Mixtures

William M. Dehn and August A. Wagner*

SINCE explosives are measured in masses whose data are in terms of the cube function, but, when exploded, exert their force upon surfaces whose data are in terms of the square function, it is obviously difficult and inconsistent to represent comparative strengths of explosives in terms of the line function. Nevertheless this is done, and at present seems convenient and necessary with modern methods of measurement, and accounts for some variations of data as derived with different explosives. This fundamental difficulty is further complicated by the fact that explosive power is a product function of gas volume, heat and rate of detonation; these may vary with different explosives and, under changed conditions, with the same explosive. Furthermore, all of the energy of explosives cannot be converted into explosive work. Most of it is lost in the form of heat; the balance is a combination of compressive, disruptive and ballistic effects. Finally the problem is complicated by variations in confinement, texture, density and the geometrical form of the mass, since these modify sensitiveness, combustion and rate of detonation. Usually the technique of measurement of strength is based on constants of weight and density of the charges, whereas less consideration is given to other factors, such as the texture of the explosive, the confinement of the charge, the optimum surface contact of detonator with the charge and the optimum surface contact of the charge with the external confining load. Obviously it is impossible to keep all of these factors constant, especially when comparing different explosives, whose densities vary.

The method of strength measurement that most closely approaches in kind the nature of the work to be done by the explosive, should give the most valuable data, provided that varied weights and densities can be made to give concordant data.

The sand test, giving fragmentation effects, offers a method of measurement of strength of high explosives used for disruptive purposes. In its different modifications,[1] the sand test has been used as the most practical method for measuring the explosive strength of detonators, yet little use has been made of it for measuring the strength of high explosives. The method hitherto employed is as follows: About 0.4 g. of the explosive is placed in the bottom of a blasting cap case (Nos. 6 or 8) and this is covered with the desired weight of mercury fulminate or other initiating explosives. The material is given the desired density of loading by applying pressure to a rammer that fits into the detonator case. The cap is then crimped into the safety fuse or the electric bridge is sealed into the case for electric firing.

Objections to this method of loading are the insufficient confinement afforded some explosives by the thin copper capsule used and the limited area of high explosives in contact with the initiating charge, since they are only end to end.

To overcome these objections, to simplify loading and to make the sand test applicable to all explosives and explosive mixtures, it was decided to fix the charge outside of the detonator case in a larger lead capsule thus obtaining in these experiment 9-18 times more contact surface of detonator with the explosive charge. This method has proved to be successful and under properly observed conditions, duplicate measurements of the strength of high explosives can be made in an hour.

The conditions that were sought to be controlled were as follows:

1. Constant charge of detonator.
2. Large constant surface of detonator in contact with the charge.
3. Constant surface of the charge in contact with the lead capsule and sand.
4. Constant fineness of the powder.
5. Constant confinement afforded by the lead capsule.
6. Practically constant weight of the charge.
7. Practically constant volume of the charge.

It is evident that both constant weights and volumes of the charges cannot be made with different explosives whose densities vary, nor are they desirable if by compression sensitiveness is changed.

The Lead Capsule

Selby assay lead foil 1/8 mm. thick was used to make the capsule. Such foil weighs 12.2 g. to 100 sq. cm. and a finished 9 lap capsule weighs about 22 g. To make this 9 lap capsule, a strip of foil 6 x 30 cm. was rolled uniformly and compactly around a brass cylinder 1 cm. in diameter and then the brass cylinder was partly withdrawn so that the end of the hollow cylinder could be folded and hammered over the end of the brass cylinder, thus tightly closing its end, making its inside length 5 cm., and its thickness 1 mm. To make many measurements with the sand test, it is recommended that molded or stamped lead capsules 1 mm. thick and inside dimensions of 1 x 5 cm. be made. It was found that capsules 1 mm. in thickness afforded the necessary confinement for the explosives to be tested.

Loading the Capsule

The capsule can be loaded by one of two methods, the second method giving uniform compression and accurate measurement of volume and density.

The Rapid Method. While holding the capsule in the vertical position, a No. 8 blasting cap, crimped on the

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[1] Snelling, Proc. Eng. Soc. Western Pa., p. 673 (1912); Storm and Cope, U. S. Bur. Mines Tech. Papers, 125 and 162; Dehn, Chem. Met., Vol. 27, No. 16, Oct. 18 (1922).

necessary length of blasting fuse, is held centered in the capsule and a weighed quantity of the explosive on a creased stiff glazed paper is run into the capsule and pressed into the same by a conveniently shaped wooden rammer. The loading here should be over a wide glazed paper so that material falling thereon can be retransferred to the creased glazed paper and finally into the cylinder. When all of the weighed explosive has been transferred to the capsule, the latter is folded, then crimped and the finger is pressed onto the blasting cap so that the capsule contains a minimum of air and is firmly attached to the blasting cap and fuse.

The Accurate Method. The lead capsule is weighed accurately and then placed in a snug-fitting hole in a metal block. A spacer about 0.05 mm. larger in diameter than a No. 8 blasting cap is centered in the capsule and held by one hand while approximately 1 g. of uniformly meshed explosive is run into the capsule and pressed down by the other hand with a hollow brass cylinder rammer fitting over the spacer and within the capsule. The rammer and spacer are then removed and the capsule containing the shaped explosive is weighed, so that the weight of charge (f) can be accurately found. The length of the charge (g) is measured by means of a narrow ruler inserted in the capsule and this, with the cross-section area of the charge, enables one to calculate the density of loading (h). The blasting cap attached to fuse or wires is then inserted in the center of the shaped explosive and the lead capsule is folded and crimped thereto for firing in the detonation bomb.

The Method of Firing

This is described in detail in the earlier papers. The bomb employed is the type described by one of the authors in his paper entitled "Modification of the Sand Test for Detonators," Chem. Met. Eng., 27, 784-7 (1922). Instead of 500 g. of Ottawa standard sand, 600 g. were always used. Only unchanged recovered 20-30 mesh sand was weighed after firing and screening, the difference between its weight and the 600 g. being the weight of sand crushed (i) by both the detonator cap and the high explosive. The difference between this and the detonator factor (113.5 g.) is the explosive factor or sand crushed by the high explosive (j). Calculation of the weight of sand crushed by 1 g. of the high explosive (k) can then be made. The detonator caps used throughout were No. 8 California blasting caps, whose cases weighed 1.24 g., whose charges[2] weighed 1.23 g. and whose strength as measured by the sand test, was 113.5 g. of crushed sand.

In preliminary experiments with TNT and mixtures of it with ammonium nitrate, compressions of 1,000 lbs. to the square inch were applied. These experiments gave discordant data, as also did samples which were not finely powdered. Finally it was observed that if uniform 30 mesh samples were prepared, if they were hand pressed in 9 lap lead capsules, thus giving uniform dispersion during explosion, the measurements could be made practically independent of the density of the charge. In other words, an insensitive explosive must be in a fine state of subdivision and must be adequately confined to register properly its strength in the sand test.

A comparison of experiments involving different numbers of laps of lead foil demonstrates that the 9 lapped capsules give maxima of sand crushed, notwithstanding that no demolition corrections were made for this additional weight of the lead. Adequate confinement thus seems the most important factor. Capsules made of other metals possessing greater tensile strength probably will be more useful. These experiments also showed that the materials to be tested must be in a fine state of sub-division. Furthermore, they showed the advantage of the material being (1) in large surface contact with the detonator and (2) in large contact with the sand.

Maxima of Strength in Explosive Mixtures as Measured by the Sand Test

In the foregoing it was shown that the sand test can be used for rapid and accurate measurement of the strength of explosives and their mixtures. Applying the improvement in technique, thus derived, we next made a study of the following:

Common Name	Chemical Name	Formula
TNT	Trinitrotoluene	$C_7H_5O_6N_3$
Tetryl	Tetranitromethylaniline	$C_7H_5O_8N_5$
Picric Acid	Trinitrophenol	$C_6H_3O_7N_3$
Explosive D	Ammonium picrate	$C_6H_6O_7N_4$
Hexil	Hexanitrodiphenylamine	$C_{12}H_5O_{12}N_7$
TNB	Trinitrobenzene	$C_6H_3O_6N_3$
Ecrasite	Ammonium trinitrocresol	$C_7H_8O_7N_4$
	Trinitroanisol	$C_7H_5O_7N_3$

[2]The conventional weight of the charge of a No. 8 blasting cap is 2 g; the California caps used here have a different composition from that of the conventional blasting cap. Since blasting caps vary somewhat in storage, the average strength of each new lot must be measured. See factor 117 following.

Table I

a No. of Expt.	b Percentage of TNT	c Percentage of NH_4HO_3	d Combustion of Carbon to	e Laps of Lead Foil	f Weight of Charge	g cm. Length of Charge	h Density of Charge	i Total Crushed Sand	j Crushed Sand Minus 113.5 g.	k Sand Crushed by 1 g. Explosives
1	.....	100.	.....	1.5	1.0590	1.75	1.34	157.0	43.5	41.08
2	.....	100.	.....	6.0	1.0963	2.70	0.90	181.0	67.5	61.67
3	.....	100.	.....	9.0	1.0800	2.00	1.20	180.0	66.5	61.57
4	100.	.....	CO–C	1.5	1.0320	1.86	1.24	204.0	90.5	87.69
5	100.	.....	CO–C	6.0	1.0480	2.30	1.01	227.0	113.5	110.80
6	100.	.....	CO–C	9.0	1.0240	1.40	1.62	235.0	121.5	118.70
7	21.27	78.73	CO_2	1.5	1.0652	2.30	1.02	212.0	108.5	101.90
8	21.27	78.73	CO_2	6.0	1.0800	2.50	0.96	240.0	126.5	117.10
9	21.27	78.73	CO_2	9.0	1.0431	2.10	1.10	242.0	128.5	123.20
10	21.27	78.73	CO_2	12.0	1.0869	2.00	1.25	237.5	124.0	101.70
11	33.02	66.98	CO–CO_2	1.5	1.0770	2.25	1.06	217.5	104.0	96.56
12	33.02	66.98	CO–CO_2	6.0	1.0710	2.20	1.08	242.0	128.5	120.00
13	33.02	66.98	CO–CO_2	9.0	1.0830	.....	.....	250.0	136.5	126.00
14	44.77	55.23	CO	1.5	1.0674	2.40	0.99	216.0	102.5	97.47
15	44.77	55.23	CO	6.0	1.0790	2.40	0.99	243.0	129.5	120.00
16	44.77	55.23	CO	9.0	1.0840	2.00	1.20	248.0	134.5	124.00

These explosives (b) were studied not only in the pure form but also in mixtures of the same with ammonium nitrate (c) and with ammonium perchlorate (d). The mixtures were prepared in accordance with the weights represented by the equations necessary to give respectively the theoretical combustion of carbon to CO_2, to CO and to 50-50 mixtures of these compositions.

As described above, the charge (e) was loaded into a 9 lapped lead foil capsule, the length of the charge (f) was measured and, by use of the constant, 0.451 cm. cross section, the density of the charge (g) was calculated. The capsules were exploded in the detonation bomb in 600 g. of 20-30 mesh Ottawa sand by No. 8 California blasting caps, whose constant of strength was estimated as 117 g. of crushed sand. The unchanged 20-30 mesh sand was weighed (h), and subtracted from 600; from this the 117 g. was subtracted to obtain the explosive strength (i) of the charge. Finally the explosive strength of the explosive (j) was calculated. The V 1,000 values (1) were calculated by Mendeléeff's method.[3] In all cases, duplicate or triplicate analyses were made and a mean value was taken.

[3]See Bernadou's "Smokeless Powder," page 97, for a translation of Mendeléeff's paper. Mendeléeff's method of comparing the strength of explosives on the basis of the V-1000 values and his conclusion that the combustion of carbon to CO is the optimum concentration are not substantiated by the data of this paper.

Maxima of Explosive Strength

From study of the table it is observed that maxima of strength, as indicated by crushed sand, are given by tetryl, TNT, picric acid, Explosive D, TNB, hexanitrodiphenylamine and ecrasite in mixtures with either ammonium nitrate or ammonium perchlorate at points of concentration designated by CO-CO_2; by trinitroanisol at CO_2 with these salts; by Explosive D at CO_2 with ammonium nitrate; by picric acid at CO with ammonium perchlorate. Usually, therefore, *maxima of strength lie near or between concentrations of explosive mixtures that yield respectively CO and CO_2 for the combustion of carbon.*

Since combustion to CO always gives greater gas volume than combustion to CO_2 and since, conversely, greater heat of combustion is yielded by burning to CO_2, it follows, theoretically, if the rate of detonation is ignored, that maxima of explosive strength should lie at some point between concentrations designated by CO and CO_2.

Because ammonium perchlorate gave higher and more regular effects than ammonium nitrate in these explosive mixtures, it is concluded that the former is a more energetic oxidant than the latter. In other words, notwithstanding its lesser contribution to gas volume, ammonium perchlorate excels as an oxidant because its mixtures are more highly sensitized, a conclusion confirmed by study of

Table II

a No. Exp.	b Explosive	c Per Cent. Ammonium Nitrate	d Per Cent. Ammonium Perchlorate	e Weight of Charge	f c. m. Length of Charge	g Density of Charge	h Grams Sand Crushed	i Crushed Sand Minus 117 g.	j Sand Crushed by 1 g.	k Explosive Gases for Carbon	l V 1000
1	.....	100.	.....	1.0800	2.0	1.20	183.5	66.5	61.57	.....	87.5
2	.....	.....	100.	1.0730	.....	.....	177	60.0	55.90	.....	72.3
3	TNT.....	.....	.....	1.0240	1.4	1.62	238.5	121.5	118.7	CO + C	66.6
4	"	.....	68.49	1.0650	1.5	1.57	257	140.0	131.5	CO_2	65.5
5	"	.....	55.25	1.0750	1.3	1.83	261	144.0	134.0	CO + CO_2	.....
6	"	.....	42.01	1.0818	1.6	1.50	259	142.0	131.3	CO	77.6
7	Tetryl.....	.....	.....	1.0466	1.7	1.36	265	148.0	138.4	11CO + 3C	73.2
8	"	70.33	.....	1.0830	2.0	1.19	260	143.0	132.4	CO_2	77.5
9	"	49.91	.....	1.0780	1.9	1.26	265	148.0	137.2	CO + CO_2	.....
10	"	29.49	.....	1.0770	2.0	1.19	260	143.0	132.7	CO	81.05
11	"	.....	58.20	1.0792	1.7	1.41	278	161.0	149.2	CO_2	64.65
12	"	.....	38.96	1.0806	1.7	1.41	281	164.0	151.8	CO + CO_2	.....
13	"	.....	19.72	1.0640	1.6	1.47	269	152.0	142.9	CO	77.18
14	Picric Acid.....	.....	.....	1.0700	2.1	1.13	256	139.0	129.9	11C + C	74.2
15	"	69.42	.....	1.0800	2.0	1.20	257	140.0	129.6	CO_2	76.1
16	"	41.87	.....	1.0750	2.0	1.19	260	143.0	133.0	CO + CO_2	.....
17	"	14.32	.....	1.0800	2.1	1.14	256	139.0	128.7	CO	78.03
18	"	.....	57.15	1.0550	2.0	1.17	269	152.0	144.0	CO_2	62.86
19	"	.....	33.23	1.0780	1.9	1.26	269	152.0	141.0	CO + CO_2	.....
20	"	.....	9.32	1.0580	2.1	1.12	259	142.0	134.2	CO	76.02
21	Explosive D.....	.....	.....	1.0684	1.7	1.39	210	93.0	87.0	2CO + C	73.2
22	"	72.24	.....	1.1020	2.0	1.22	229	112.0	101.8	CO_2	79.0
23	"	55.83	.....	1.0890	2.2	1.10	239	122.0	112.2	CO + CO_2	.....
24	"	39.42	.....	1.0240	1.8	1.26	235	118.0	115.0	CO	83.7
25	"	.....	60.45	1.0940	.....	.....	235	118.0	109.2	CO_2	66.2
26	"	.....	44.05	1.0822	1.7	1.41	245	128.0	118.7	CO + CO_2	.....
27	"	.....	27.65	1.0789	1.7	1.37	234	117.0	108.4	CO	78.8
28	Hexil.....	.....	.....	1.0690	1.8	1.32	242	125.0	117.0	19CO + 5C	70.7
29	"	72.55	.....	1.0750	1.8	1.32	244	127.0	118.1	CO_2	76.9
30	"	51.93	.....	1.0650	1.7	1.39	245	128.0	120.2	CO + CO_2	.....
31	"	31.31	.....	1.0830	1.9	1.26	245	128.0	118.5	CO	87.6
32	"	.....	51.38	1.0900	1.4	1.73	262	145.0	133.0	CO_2	63.16
33	"	.....	36.25	1.0810	1.5	1.63	256	139.0	128.8	CO + CO_2	.....
34	"	.....	21.11	1.0780	1.8	1.33	255	135.0	125.3	CO	75.46
35	TNB.....	.....	.....	1.0824	2.0	1.20	244	127.0	117.3	3CO + C	70.4
36	"	73.79	.....	1.0932	1.8	1.35	251	134.0	122.6	CO_2	77.44
37	"	54.92	.....	1.0846	1.8	1.34	258	141.0	130.1	CO + CO_2	.....
38	"	36.05	.....	1.0890	2.0	1.21	253	136.0	124.8	CO	81.05
39	"	.....	62.33	1.0800	1.5	1.60	236	139.0	128.7	CO_2	63.65
40	"	.....	43.59	1.0879	1.7	1.42	257	140.0	128.2	CO + CO_2	.....
41	"	.....	24.86	1.0730	2.0	1.19	253	136.0	126.7	CO	76.19
42	Ecrasite.....	.....	.....	1.0460	2.5	0.93	229	112.0	107.1	3CO + 4C	69.2
43	"	77.20	.....	1.0934	2.1	1.15	246	129.0	118.0	CO_2	80.70
44	"	66.19	.....	1.0960	1.9	1.28	248	131.0	119.5	CO + CO_2	.....
45	"	55.18	.....	1.0810	2.1	1.14	239	122.0	112.9	CO	86.19
46	"	.....	66.53	1.0910	1.9	1.27	256	139.0	127.4	CO_2	67.43
47	"	.....	54.24	1.0910	2.0	1.21	258	141.0	129.3	CO + CO_2	.....
48	"	.....	41.95	1.0786	2.1	1.14	253	136.0	126.0	CO	79.4
49	Trinitro Anisol.....	.....	.....	1.0900	.....	.....	259	142.0	130.3	9CO + 5C	69.9
50	" ..	75.76	.....	1.0950	1.8	1.35	234	117.0	106.9	CO_2	79.0
51	" ..	60.46	.....	1.0930	2.1	1.15	259	142.0	129.9	CO + CO_2	.....
52	" ..	45.16	.....	1.0900	1.7	1.42	276	156.0	143.0	CO	83.5
53	" ..	.....	64.75	1.0853	.....	.....	267	150.0	138.2	CO_2	64.96
54	" ..	.....	48.62	1.0910	.....	.....	270	153.0	140.2	CO + CO_2	.....
55	" ..	.....	32.50	1.0930	.....	.....	273	153.0	142.6	CO	77.76
56	Ammonal.....	86.64	Al 18.36	1.0730	2.0	1.19	260	143.0	133.3	.....	61.2

the table below in which the strength of the explosives as measured by the sand test are correlated with sensitiveness, etc. Free ammonia found in the sand after firing indicates, of course, incomplete explosion of materials. Ammonia was more frequently found after firing ammonium nitrate mixtures. This free ammonia suggests that the confinement afforded by the nine laps of lead foil in the capsule was insufficient, for some of the explosive mixtures.

Order of Explosives

Strength by Sand Test	Sensitiveness (1)	Ballistic Mortar Values (2)	Pressure in own Volume (3)	Velocity of Detonation (4)	Brisance (5)	Trauzl Test (6)	Gas Volume (7) V1000
Tetryl	Trinitroanisol	Tetryl	Explosive D	TNT	Tetryl	Tetryl	Amatol
Trinitroanisol	Tetryl	Amatol	Hexil	Tetryl	Pieric A	Pieric A	Ecrasite
TNT	TNT	Hexil	Tetryl	Explosive D	TNT	TNT	Explosive D
Pieric A	Pieric A	Pieric A	Trinitroanisol	Hexil			TNT
Amatol		Explosive D	TNT	Pieric A			Trinitroanisol
Hexil		Trinitroanisol					Hexil
TNB	Explosive D	TNT					Tetryl
Ecrasite							TNB
Explosive D	Amatol		Amatol	Amatol			Pieric A

(1) Howell, U. S. Bur. Mines Tech. Paper, 234. Marshall's Explosives, p. 429, order given is: tetryl, pieric acid, TNB, TNT and trinitroanisol. Barnett's Explosives, p. 210, order given is: pieric acid, hexil, tetryl, TNT and Explosive D. (2) Cope, J. Ind. Eng. Chem., *12*, 870 (1920). (3) Crawshaw, J. Franklin Inst., *189*, 607 (1920). (4) The comparisons are made from data of Cope (loc. cit.) and of Kast (Z. ges. Schiess Sprengstoff, 1913, 65, 88, 133, 155, 172). See also Olsen, Army Ordnance, II, 229 (1922). (5) Barnett, Explosives, p. 185. (6) Barnett, Explosives, p. 181. See also Neumann, Z. Angew. Chem., 1911, 2234. (7) See (1) of table. The sums of V 1000 for CO and CO_2 for both ammonium nitrate and ammonium perchlorate give the order.

In the table are included eight different physical constants of these explosives. Study of this table shows that there is not agreement amongst them as to the true order of strength. Because strength is the product of temperature, gas volume, and rate of detonation and is influenced by sensitiveness, confinement, density, granulation, etc., it is obvious that varied conditions under which explosive physical constants are determined will alter readings of strength.

Summary and Conclusions

1. Studies by the sand test under constant conditions have been made of eight military explosives in mixtures with ammonium nitrate and ammonium perchlorate.

2. Sensitive explosive mixtures are readily responsive to the sand test. Insensitive explosives must be adequately confined.

3. Maxima of explosive strength as measured in this test have been found in the concentrations lying between percentages yielding respectively CO and CO_2 for combustion of the carbon.

4. Order of strength of these explosives, as determined by the sand test, compares favorably with the orders as ascertained by other methods.

Army Officers Inspect Pittsburgh Industrial Plants

A PARTY of about fifty officers of the Regular Army representing the students of the Army Industrial College, the Office of the Assistant Secretary of War, and the War Plans personnel of the several supply branches of the Army recently spent three days in visiting some of the larger industrial plants of the Pittsburgh Procurement District. The purpose of the trip was to give the student officers an opportunity to observe large scale production in various industries in connection with the studies they are pursuing in the College on industrial preparedness.

Executives of the Carnegie Steel Company, the National Tube Company, the Westinghouse Electric & Manufacturing Company, the Jones & Laughlin Steel Corporation, the Dravo Contracting Company and the Duquesne Light Company conducted the officers through their respective plants. These industrial leaders showed much interest in the War Department plans for industrial mobilization in a national emergency and expressed themselves as heartily in favor of the work that has been done in this regard.

Through the courtesy of the Pittsburgh Athletic Association, the party enjoyed the privileges of the club during its stay in Pittsburgh, while the officials of the plants visited showed their interest in the work of the College by providing transportation and luncheons for the group as well as by opening their works to a detailed inspection by the class. Several interesting dinner talks by prominent industrialists were given, notably one on "Coal," by Dr. J. H. James of Carnegie Institute of Technology; one on "Steel," by Dr. C. B. Francis of the Carnegie Steel Company, and one on "Power," by Major M. R. Scharff, O. R. C., of the Byllesby Engineering and Management Corporation.

Editorial

The Chicago Tribune Asks a Question

THE Chicago *Tribune* of July 6, 1927, very naively raises a question in an editorial entitled "Modernizing the Technique of War" which leads one to conclude that some citizens of our mid-western metropolis are not quite as well informed on such matters as reasonable circumspection would enable them to be.

Let us first state the proposition in the words of the *Tribune:*

"We trust our general staff is more than interested in the active experimentation in the British army with mechanical means of transport and the news of devices such as tanks and armored cars. David Darrah of the *Tribune's* press service cabled recently that training is going on rapidly, and the *London Times* says editorially that 'the blessed word "mechanization" is now blessed officially by the army council instruction and mechanization in the army has entered upon a new phase.' It has progressed, says the *Times,* beyond the stage of discussion and technical research to that of practical military experiment.

"How far along is our Army? In the field of applied mechanics and alert initiative in the use of new inventions the American civilian mind does not lag. What of our military minds? The *London Times* says: 'More than eight years have passed since the Armistice and controversy still rages over the part to be played by horse, man, and machine. New means of transport, capable of traveling at speed across country or by road, and new developments of fighting vehicles like the tank and armored car have been invented and have passed preliminary tests. Their mobility and their terrible potentialities in concentration of fire power were demonstrated before the dominion premiers and others at Camberley last November.' But mechanization, of course, involves corresponding changes in organization and tactics, and the British Army has now passed on to practical experiment in this final phase. An experimental force has been formed and has been in training on Salisbury Plain. There is complaint that it is too small, but it is certainly a long step forward.

"The British tactics in the last war undoubtedly were frightfully costly and ineffective in proportion to the expenditure. The tragedy of British losses in interminable but futile assaults has got home, it seems, to the British military mind, conservative though it is. But our wastage was as bad or worse. Has our military mind learned anything from it? We have seen no very striking signs that it has been highly energized for progress. Some innocent remarks in these columns on the obsolescence of the horse and the need for mechanization brought forth a flood of protests, including one from a former chief of staff, but only one of agreement from a professional soldier. Doubtless there are many officers like General Rockenbach who are working for the future rather than living in the past. But one specialist cannot change the policy of an army. What of the authoritative opinion and the actual activities of the Army for keeping abreast of an age of applied science and the universal march of the machine in all industries and activities?"

Since the question is here so squarely put may we take the liberty to inform the questioner, and all others who labor under the same impression, as to what, from an unofficial but intensely interested viewpoint, might be the answer.

We can quote no greater authority than Maj. Gen. C. C. Williams, Chief of Ordnance, U. S. A., on the status of tank and tractor development in the Army. In his annual report for the year 1926 General Williams said: "Design and development work on tanks during the year has been principally on the medium 25-ton tank; although some preliminary study work has been done on the light tank. The test of the original pilot 1921 and 1922 medium tanks has continued, including the test of the new Packard engine, and two types of clutches which will later go in the third medium tank produced, which is well under way at the Rock Island Arsenal. The test of this new engine in the model of 1921 tank will be in the nature of a preliminary test of the engine and clutches, and possibly other equipment to go into the new pilot.

"A high-speed test of the medium tank, model of 1922, was conducted which demonstrated that it is possible to operate this tank across country at speeds up to sixteen miles an hour. Although this test resulted in considerable damage to the engine, it proved that the transmission and other mechanisms in the power train are capable of carrying the load, and it is believed that with a proper power plant high speeds are feasible.

"The service test of the 'Caterpillar 30' tractor progressed to a point where the Chief of Field Artillery recommended its adoption as a standard medium tractor, and the necessary steps to complete standardization of this vehicle have been taken. It will be shown as the standard medium tractor in the next revision of the Book of Standards, and the five-ton tractor, model of 1917, which was formerly standard, will be carried as a substitute.

"The 'Caterpillar 60' test was completed, and the Chief of Field Artillery recommended that it be standardized as the heavy military tractor. After being cleared for procurement by the Assistant Secretary of War, the Adjutant General approved it as to type as the standard heavy tractor, to replace the ten-ton, model 1917, tractor. When revised, the Book of Standards will show the 'Caterpillar 60' as the standard, and the ten-ton, model 1917, as the substitute heavy tractor.

"Instructions were received from the War Department to determine what changes are required in the Artillery repair truck, model of 1918, to render it suitable for use as a light machine shop truck for all services. Correspondence and conferences with the various branches indicated that this vehicle is practically satisfactory in its present form. It was recommended by the Ordnance Office as the standard for all branches, and was so adopted by the War Department."

In his report for the preceding year General Williams discussed the same subjects in the following terms:

"Tanks: All design and development work during the year has been centered on the medium tank. The two models, known as Models of 1921 and 1922, have been thoroughly tested at the Proving Ground and at the Tank Center at Camp Meade. Through concurrent action with the General Staff and the Tank Service it has been decided that the Model of 1921 tank will be the most satisfactory type to develop for service use.

"Tractors: The Ordnance Department during the past year has continued its search for suitable commercial tractors to handle the standard military loads presented by the old and new designs of equipment which have been produced. Although the commercial tractors do not exactly meet military requirements in all particulars, the tests of several types have indicated that they can be used to great advantage, since they can be made quickly available in time of emergency, for divisional tractors.

"Reconnaissance Vehicles: To carry the reconnaissance party or motorized artillery organizations across country, attempts have been made to develop a satisfactory light caterpillar vehicle, without material success. In this attempt to secure a vehicle of light ground pressure, a Ford touring car chassis was equipped with balloon tires, bucket seats, and an auxiliary low speed transmission. Under test this vehicle has shown remarkable cross-country ability, and apparently fills the military requirements for a cross-country reconnaissance car."

This much in reply to the inquiring of the *Tribune*, "What of the authoritative opinion and actual activities of the Army for keeping abreast of an age of applied science and the universal march of the machine in all industries?"

The *Tribune* further refers to the experimental force which has been formed in England and which has been in training on Salisbury Plain. In no spirit of rivalry of the excellent work of the British in this respect but simply as a reminder to our own people—and particularly to the *Tribune*—may we point out that the American Army has the following motorized units of Field Artillery: the 5th Field Artillery (155-mm. guns, 240-mm. howitzers and 8-inch guns) at Fort Bragg, N. C.; the 8th Field Artillery (75-mm. guns) at Schofield Barracks, Hawaii; the 11th Field Artillery (155-mm. howitzers) at Schofield Barracks; the 13th Field Artillery (75-mm. guns) at Schofield Barracks; the 17th Field Artillery (155-mm. howitzers) at Fort Bragg, N. C.; and the 83rd Field Artillery Battalion (75-mm. guns) at Fort Benning, Ga. In addition, the first Field Artillery at Fort Sill, Okla., is a combined horse-drawn and motorized unit. To be sure there are some 17 active horse-drawn units while there are some 24 inactive units divided between horse-drawn and motorized.

Add to these the Tank Group at Camp Meade, Md., the 15th (Special) Tank Battalion at Fort Benning, Ga., the 16th (Light) and the 17th (Heavy) Tank Battalions at Camp Meade, Md., and the following Tank Companies: the 1st at Miller Field, New York; 2nd at Fort Sam Houston, Texas; 3rd at Camp Lewis, Wash.; together with the 1st Platoon of the 4th Company at Camp McClellan at Ala.; the 1st Platoon of the 5th Company at Fort Benjamin Harrison, Ind.; the 1st Platoon of the 6th Company at Jefferson Barracks, Mo.; the 1st Platoon of the 7th Company at Fort Snelling, Minn.; the 1st Platoon of the 8th Company at Camp Meade, Md.; the 1st Platoon of the 9th Company at Boston, Mass.; and the 11th Company at Schofield Barracks, Hawaii.

Thus it would appear that both in technical development and tactical employment of "mechanization' 'the American Army is not as sluggish as the *Tribune* seems to infer. As a matter of fact American forces are as well equipped and trained with motorized vehicles as the expediency of the time permits. Aside from the moot question of the horse versus the motor in war, reduced to its simpliest terms a complete motorized army is merely a matter of dollars and cents. The Ordnance Department and the Army, it may be assumed, are ready and willing to motorize to the limit of their authorized needs but the decision rests with neither of them. Our three types of tanks, our tractors and our reconnaissance cars need no apology: they will stand comparison with those of any other nation. But the fact that we have not enough of them is not a deficiency to be hurled at the General Staff, the Ordnance Department, or any other component of the Army.

Antiaircraft Tests

A RECENT announcement of the War Department that tests of improved antiaircraft ordnance will be conducted again this year is very encouraging. During the past few years the programs of antiaircraft tests at the Aberdeen Proving Ground have been productive of excellent results. For one thing they have brought together members of the several branches of the Army concerned with the tactical employment of antiaircraft matériel thus bringing the designer and user into close contact for the solution of mutual problems. They have also served to iron the wrinkles out of equipment and help bring American antiaircraft equipment to its present high stage of development.

The matériel to be tested this year will consist chiefly of guns, machine guns, fire-control apparatus and sound locators being developed by the Ordnance Department, searchlights being developed by the Engineers, and targets and towing equipment being developed by the Air Corps. The exercises are scheduled to begin September 1st and terminate about November 1st.

The towing of targets and other air missions will be performed by the 49th Bombardment Squadron, stationed at Phillips Field, Aberdeen Proving Ground. The antiaircraft matériel consisting of guns, machine guns, searchlights, and fire-control apparatus, will be manned by the 61st Coast Artillery (Antiaircraft) from Fort Monroe, Virginia, reinforced by a detachment of the 62nd Coast Artillery (Antiaircraft) from Fort Totten, New York.

Professional

Rules for National Rifle Matches, 1927

RULES and regulations which will govern the National Rifle Matches for 1927, to be conducted under the auspices of the National Rifle Association of America, in cooperation with the United States Army, under direction of the Secretary of War, at the Ohio State rifle range, Camp Perry, Ohio, beginning September 1, have been announced by the War Department.

The place and time were determined by the National Board for the Promotion of Rifle Practice, which convened January 29, in Washington, D. C. The decision had the approval of the Secretary of War, Dwight F. Davis.

The full text of the rules and regulations follows:

1. The proceedings of the National Board for the Promotion of Rifle Practice, convened at Washington, D. C., January 29, 1927, having received the approval of the Secretary of War, the following excerpt therefrom relating to the establishment of a Citizens' Military Training Camp for civilians engaging in practice at the Small Arms Firing School and rules and regulations for the national matches, 1927, is published for the information of all concerned.

All conflicting regulations previously issued are hereby revoked, and such points as are not governed by these rules will be governed by the provisions of Rifle Marksmanship (TR 150-10) and Pistol Marksmanship (TR 150-20).

National matches. 2. For the year 1927 the national matches and the matches of the National Rifle Association of America will be held under the direction of the Secretary of War at the Ohio State rifle range, Camp Perry, Ohio, commencing Thursday, September 1, 1927.

The matches will begin in the following order:

a. National Rifle Association matches.
b. National individual rifle match.
c. National individual pistol match.
d. National pistol team match.
e. National rifle team match.

On Thursday, September 15, 1927, the range will be open for final preliminary team practice.

National Rifle Team Match. 3. Open to teams of 10 firers from the following:

a. The Army of the United States, one from each of the several branches.
b. The United States Navy, one.
c. The United States Marine Corps, one.
d. The United States Military Academy, one.
e. The United States Naval Academy, one.
f. The federally recognized National Guard (including the Naval Militia) of the several States and Territories, including the District of Columbia, one from each.
g. The Reserve Officers' Training Corps, one or more.
h. Citizens' Military Training Camps, one or more.
i. School teams composed of students of universities, colleges, and schools, one or more from each State, Territory, and the District of Columbia.
j. Civilian teams, one from each State, Territory, and the District of Columbia, selected by competition.
k. Any organization composed of veterans of any war or wars in which the United States has been engaged, one or more.

4. There will be established and maintained at the Ohio State rifle range, Camp Perry, Ohio, between the dates of August 21 and September 18, 1927, under the provisions of section 47d of the National Defense Act of June 3, 1916, as amended by the Act of June 4, 1920, a Citizens' Military Training Camp for the instruction of civilians of the United States in marksmanship.

5. Each corps area commander is authorized to select representatives from the Citizens' Military Training Camps and the Reserve Officers' Training Corps camps established within his corps area under such regulations as he may prescribe pursuant to regulations established by the Secretary of War.

Additional civilians may be designated to attend the Small Arms Firing School at Camp Perry, Ohio, under regulations prescribed by the Secretary of War and within the limits of available appropriations.

6. Course of fire:

First stage—Slow fire, 200 yards—target "A." Ten shots. Standing. Time limit, one minute per shot. No sighting shots. The gun sling will not be used and will be adjusted to what is known as the parade position. The forward hand shall be extended so that the arm will be entirely free from touching or resting against the body.

Second stage—Rapid fire, 200 yards—target "A." Ten shots. Kneeling or sitting, from standing. Time limit, one minute. Battle sight or leaf sight may be used.

Third stage—Rapid fire, 300 yards—target "A." Ten shots. Prone from standing. Time limit, one minute, ten seconds. Battle or leaf sights may be used.

Fourth stage—Slow fire, 600 yards—target "B." Ten shots. Prone. No sighting shots. No artificial rest.

Fifth stage—Slow fire, 1,000 yards—target "C." Twenty shots. Prone. No sighting shots. No artificial rest.

7. The executive officer, at his discretion, at any time after the first stage may eliminate from further participation in the match any number of teams of lower standing in excess of a remaining number of 50 teams.

8. Rules—As laid down in Rifle Marksmanship (TR 150-10), except as herein modified.

9. Arm—United States rifle, caliber .30, model 1903.

10. The Ordnance Department is authorized to select

star-gaged and targeted rifles of as high grade as can be produced for the use of teams and individuals participating in the matches for issue or sale on the grounds by the ordnance officer of the matches.

11. Such necessary orders and instructions regarding the issue of arms and equipment to, and return thereof by, civilians attending national matches, as are necessary to provide adequate protection to the United States, will be published by the executive officer of the national matches.

12. Ammunition—Ammunition issued by the Ordnance Department. Ammunition will be issued to the competitors at the firing points. No other ammunition will be used in the national matches. Ammunition will be issued to all competitors for practice prior to the national matches, including practice in the matches held prior to the national matches.

All ammunition remaining at the close of the national matches shall be disposed of as the Ordnance Department may direct.

13. Civilians desiring to procure rifles and ammunition for practice in advance of their arrival at Camp Perry will make application therefor to the Director of Civilian Marksmanship, War Department, Washington, D. C. Under the law annual and life members of the National Rifle Association of America are entitled to purchase rifles and ammunition from the War Department. Each rifle club affiliated with the National Rifle Association of America is entitled to a free issue of two United States rifles, model 1903, and to an allowance of ammunition therefor.

14. Classification—After the national rifle team match the teams shall be classified as class A, class B, class C, or unclassified. In each of these first three classes there shall be listed 10 teams, and in addition thereto such teams representing the several branches of the Army, the Navy, and the Marine Corps, as would be entitled to such classification by virtue of their respective total scores if there were but 10 teams in each class. A distinctive badge will be awarded each member of each team in class A, class B, and class C. All teams not listed in class A, class B, class C shall be unclassified.

15. For the awarding of the badges referred to above each team officer and alternate herein provided for shall be awarded a badge.

16. One trophy shall be awarded to the highest team representing the United States services. One trophy shall be awarded to the highest team from the National Guard or State troops of the several States and Territories, including the District of Columbia. One trophy shall be awarded to the highest team representing the Citizens' Military Training Camps and the Reserve Officers' Training Corps. One trophy shall be awarded to the highest civilian team.

Among the above stated trophy teams the National Trophy shall be awarded to the highest team, the Hilton Trophy to the second highest team, the "Soldier of Marathon" to the third highest team, and "The Minuteman" to the fourth highest team.

17. At least 50 per cent. of the shooting members of each team representing the several branches of the Army, the Navy, and the Marine Corps shall be men who have never before shot as members of any national rifle team.

No individual may be a shooting member or alternate on any national match rifle team representing any of the several branches of the Army, the Navy, and the Marine Corps, who has heretofore shot on any national match rifle team in more than one of the three national matches immediately preceding.

Teams other than those representing the several branches of the Army, the Navy, and the Marine Corps shall be subject to the following elimination rules:

A team listed in class A after the national matches of 1925 or after the last national match in which such team competed shall have at least 50 per cent. of its shooting members composed of men who have never before shot on any national match rifle team.

A team listed in class B after the national matches of 1925 or after the last national match in which such team competed shall have at least 30 per cent. of its shooting members composed of men who have never before shot on any national rifle team.

A team listed in class C or unclassified after the national matches of 1925 or after the last national match in which said team competed shall be subject to the following elimination rule only, to which all teams except those representing the Reserve Officers' Training Corps and the Citizens' Military Training Camps are also subject in addition to the rules prescribed above:

No team may have as a shooting member or alternate any man who has been a shooting member of any team in three or more of the five national rifle team matches immediately preceding.

For the year 1927 teams representing the Reserve Officers' Training Corps and the Citizens' Military Training Camps shall be exempt from the application of all elimination rules.

18. Each team captain upon arrival at the range shall present to the executive officer a letter from the proper authority, authorizing him to act as team captain.

All team captains will immediately then furnish a list of members of their team party, including all team officers, with the home address of each, and will certify to the eligibility of all members. The list shall contain the names of not to exceed 24 eligibles from among whom the team shall be finally selected.

19. Not later than 6 p. m. of the day of the prescribed preliminary team practice each team captain will submit to the statistical officer at his office, on a blank form furnished for the purpose, a legible list of the members of his team, showing the correct first name, middle initial, last name, rank and organization of the team captain, team coach, 10 firers, and 2 alternates.

Either or both of the alternates listed, and no others, may be substituted as shooting members at any time prior to the beginning of the score of the last pair at the initial stage of the match. Thereafter substitution may be made only on surgeon's certificate approved by the executive officer.

Either the team captain or the coach or both, if otherwise eligible under the elimination rules, may serve also as shooting members provided they have also been listed as shooting members or alternates.

20. In preparing estimates for expenses and transportation of teams the following should be provided for: 1 team captain, 1 team coach, 1 range officer, 10 principals, and 2 alternates, 15 in all.

21. For each State represented by a National Guard

rifle team the proper State authority shall select an officer of the National Guard not above the rank of captain, appoint him range officer of the team, and direct him to report to the executive officer, national matches, at Camp Perry, Ohio, on August 29, 1927, for the purpose of receiving instruction in the duties pertaining to range operation and thereafter performing those duties until the completion of the matches unless sooner relieved by proper authority.

National Pistol Team Match. 22. Open to teams consisting of a team captain and five firers and one alternate from the following:

a. The Army of the United States, one from each of the several branches.

b. The United States Navy, one.

c. The United States Marine Corps, one.

d. The United States Military Academy, one.

e. The United States Naval Academy, one.

f. The federally recognized National Guard (including the Naval Militia) of the several States and Territories, including the District of Columbia, one from each.

g. The Reserve Officers' Training Corps, one or more.

h. Citizens' Military Training Camps, one or more.

i. School teams composed of students of universities, colleges and schools, one or more from each State, Territory, and the District of Columbia.

j. Civilian teams, one from each State, Territory, and the District of Columbia.

k. Any organized police or constabulary force in the United States, one.

23. The allowances for transportation and subsistence or reimbursement therefor herein provided for members of the several national match rifle teams shall be paid only to such members of the several national match pistol teams as have also been properly designated as members of a national match rifle team.

All other members of the several national match pistol teams must provide for their own expenses, except that the executive officer is authorized to furnish all such members with tentage and such other equipment as may be available.

24. Course of fire.

First stage—Slow fire, 50 yards—Standard American 50-yard target. Two scores (five shots each); 1 minute per shot.

Second stage—Timed fire, 25 yards—Standard American 50-yard target. Two scores (five shots each); 20 seconds per score.

Third stage—Rapid fire, 25 yards—Standard American 50-yard target. Two scores (five shots each); 10 seconds per score.

25. Positions—Without body or artificial rest; one hand only to be used.

26. Arm—Colt's automatic pistol, caliber .45, model 1911, having not less than four pounds' trigger pull, as issued, except that the front and rear sights may be of commercial manufacture similar in design to the issue sights, though different in dimensions.

27. Ammunition—Ammunition issued by Ordnance Department. Ammunition will be issued to all competitors at the firing points for practice and for use in the pistol matches. No other ammunition will be used in the national pistol team match.

28. Rules—As laid down in Pistol Marksmanship (TR 150-20), except as herein modified.

29. Prizes—A trophy shall be awarded to the winning team, and to each member of the highest one-third of the teams shooting shall be awarded a badge.

INDIVIDUAL RIFLE MATCHES

Individual Matches. 30. The national individual rifle match and the national individual pistol match are open to any citizen of the United States. Entries for these events should be made as early as possible and must be made 48 hours before the beginning of each match.

31. Each team captain in the national rifle team match will see that proper entries for all members of his team desiring to enter the national individual rifle match and the national individual pistol match are properly made out and delivered to the statistical officer in one lot.

32. Individual competitors not members of regularly accredited teams may make entry in person or by mail addressed to the statistical officer, national matches, Camp Perry, Ohio.

33. The executive officer, at his discretion, at any time after the first stage of each match, may eliminate from further participation in that match any number of competitors of lowest standing in excess of a remaining number of 500 competitors.

National Individual Rifle Match. 34. Course of fire.

The course of fire and the rules in regard to arms and ammunition are the same as for the national rifle team match.

ORDER OF FIRING ON RANGES

The executive officer may, in his discretion, change the order of fire of the several ranges.

35. Prizes.

a. To each of the 15 competitors making the highest aggregate scores, a gold badge.

b. To each of the 25 competitors making the next highest aggregate scores, a silver badge.

c. To each of the 100 competitors making the next highest aggregate scores, a bronze badge:

Provided, that if the number of competitors in the national individual rifle match is less than 1,000, the total number of badges will be one for each 10 competitors, disregarding fractions; the gold, silver, and bronze medals to be in the ratio given above.

36. An appropriate badge representing qualification in the Regular Army course will be issued to all civilians who qualify as expert rifleman, sharpshooter, or marksman in the national individual rifle match. Qualifying scores: Expert rifleman, 255; sharpshooter, 230; marksman, 210.

Members of Reserve Officers' Training Corps and Citizens' Military Training Camps will obtain their insignia through their respective corps area headquarters. Other civilians will obtain their insignia from the director of civilian marksmanship as prescribed in paragraph 20d, TR 150-10.

OPEN TO ALL CITIZENS

Citizens' Military Championship Match. 37. Open to all citizens of the United States, except members of the regular services.

38. The conditions as to the course of fire and rules as to arms and ammunition to be the same as for the national individual rifle match.

39. This match to be fired in conjunction with the national individual rifle match. Scores made in the national individual rifle match to be counted for prizes in this match.

40. Prizes.

To the 10 highest competitors, gold medals.

To the next highest 15 competitors, silver medals.

National Individual Pistol Match. 41. The course of fire and rules in regard to arms and ammunition are the same as for the national pistol team match.

42. Prizes.

a. To each of the 12 competitors making the highest aggregate scores, a gold badge.

b. To each of the 24 competitors making the next highest aggregate scores, a silver badge.

c. To each of the 36 competitors making the next highest aggregate scores, a bronze badge.

43. The executive officer may, in his discretion and by such standards as he may prescribe, eliminate competitors after each stage of the national individual pistol match.

44. An appropriate badge representing qualification in the Regular Army course will be issued to all civilians who qualify as pistol expert, pistol sharpshooter or pistol marksman in the national individual pistol match. Qualifying scores: Pistol expert, 240; pistol sharpshooter, 225; pistol marksman, 210. Members of Reserve Officers' Training Corps and Citizens' Military Training Camps will obtain their insignia through their respective corps area headquarters. Other civilians will obtain their insignia from the director of civilian marksmanship as prescribed in paragraph 80, TR 150-20.

The Development of the Testing Laboratory Section, New York Ordnance District

UNDER the Organization Chart of the New York Ordnance District, provision has been made for a Testing Laboratory Section, coming under the Ordnance Division of the Engineering Service, Technical Section. The Testing Laboratory has been regarded as a very important section of this organization, in order that a proper supervision of Ordnance material may be maintained throughout the activity of a contract. There being no criterion for the organization of such a Testing Laboratory Section, it was decided to develop this Section in accordance with the results of a careful study of the probable duties that would devolve upon the Section in the event of an emergency.

It was quite evident that the testing of materials would involve the use of regular and special testing apparatus, and therefore one of the first details was that of preparing a card index on which would be recorded the location of various types of testing apparatus, so that if a particular test specimen required a particular type of testing machine, reference to the card index would indicate the location of such a machine. On this card index only one type of testing machine appears per card, and under it, the names and addresses of laboratories (industrial, technical school or commercial) in which it is to be found. On the reverse side of these cards is pasted an illustration of the particular machine or accessory in question so that it may be readily recognized, and as a further guide there appears on the title line of the card, notation as to its capacity, type number, and page of the particular catalog in which a full description may be found. Likewise, there are filed catalogues covering description of the apparatus listed so that it is a matter of relatively few moments to locate completely, the description of any apparatus required if such apparatus actually is available.

The inventory of such laboratory equipment is not confined to the limit of the New York Ordnance District. The card index records the location of apparatus irrespective of its geographical relation to the District. However, all equipment within the limitations of the District is indicated by a red check mark in the left-hand margin of the card so that it is obvious at a glance whether or not any particularly desired apparatus is readily available within the District. If not, the procedure would be to operate in conjunction with and through the nearest District in which such apparatus or testing device is a matter of record with us.

Cooperation from the Department of Commerce, Bureau of Standards, has resulted in placing at our disposal the results of surveys conducted by the Bureau relative to commercial and technical school testing laboratories, their equipment and the character of tests they are in a position to handle covering various materials and commodities. All such data are being coordinated with the files of this District so that the fullest possible benefit may be derived from this excellent survey. Cross indexing further expedites location of desired information.

A further development involves a complete study of the specifications covering all tentative contracts already placed in the District, with a view to determining the character of tests, as well as the probable amount of work which would be involved in the execution of such contracts. This study of the specifications affords an index as to the types of testing machines and equipment that will be required for each of the materials involved, and therefore, there may be developed in advance the assignment of tests to stated laboratories, according to locality of the contractor or sub-contractor. This, in turn, will also indicate the probable personnel that will be required to conduct these tests, so that provision can be made for training such personnel along the lines for which their previous professional experience may best qualify them.

At the present time we are securing personnel from the industrial and commercial testing laboratories and from the recent graduates of R. O. T. C. units in the Metropolitan District, that is to say, officers who have received their commission as 2nd Lieutenants, and whose collegiate training has been at a technical school or college of engineering, and who have recently, therefore, had a certain, though limited amount of testing laboratory work, but who are interested and willing to learn the particular character of tests called for in the various specifications previously referred to.

The training of this personnel is now under consideration. Volunteer work on the part of a few has acquainted them with the construction of the index system on which they have worked, and also with the specifications on file. However, as the development of the index files nears completion, it is intended to hold a series of lectures and laboratory demonstrations, at the Headquarters Laboratory at New York University, so that the less experienced officers

may have the proper Ordnance viewpoint of test requirements and acquire some practical knowledge of the technique of materials testing. Such lectures and laboratory work would probably be conducted on Saturday afternoons. This instruction will also include the use of standardized forms upon which all test data are to be recorded.

It is intended that from among the testing laboratories of the technical schools and colleges in the New York Ordnance District, certain laboratories will be designated as branch laboratories, selection for such designation being based upon extent of equipment, personnel, geographic location with respect to industrial centers, and the desire and willingness of the institutions to cooperate in the development of the provisions of the National Defense Act.

MAJ. CARLOS DE ZAFRA, *Ord. Res., U. S. A.,*
Chief, Testing Laboratory Section,
New York Ordnance District.

Inspection of Smokeless Powder

SMOKELESS powder is not a definite compound but rather a mixture consisting of some four or five different compounds, the principal one being nitrocellulose. The regular service powder derives all of its explosive and propellant force from the nitrocellulose. The other ingredients which are used in the powder are ether, alcohol and diphenylamine. These materials give the powder no additional power but are essential in making the nitrocellulose available for use and prolonging its life after manufacture.

The process of producing the finished powder comprises numerous steps, each of which has a bearing on the serviceability of the powder. The present method is the result of long experience, and to produce the most satisfactory powder it is necessary to follow numerous details very carefully.

The Ordnance Department specification fully prescribes the requirements of all ingredients of smokeless powder; this specification also prescribes in considerable detail the process of manufacture. Considerable time and research have been given to finding out just what are the standards of purity for the ingredients which enter into the manufacture of smokeless powder, and what are the steps which are essential in the process of manufacture to produce the best powder. It is necessary, therefore, to have a well equipped chemical laboratory and a competently trained chemist to carry out the prescribed tests as given in the specification. This will insure the Government that the ingredients which enter the powder comply with the specification for purity. Any ingredient not complying with the specification must be rejected or treated until it does meet with the requirements.

Having been assured that all of the materials needed for use in the manufacture of the powder comply with their respective requirements, there yet remains the important task of seeing that all of the details of manufacture enumerated in the specification are adhered to. This is necessary in order to obtain maximum stability life and make more certain that the powder will comply with the ballistic requirements. Even though samples of material have been taken at every stage of manufacture, sent to the chemical laboratory, tested, and found to comply with the specification, it cannot be assumed that no further inspection is needed. The reason for this is to be found in the fact that nitrocellulose, the principal ingredient of smokeless powder, even though highly purified, is not a stable compound such as sodium chloride, potassium nitrate and sugar, but deteriorates with age. There are in storage at the present time several lots of powder which contain very unstable grains. This is an unusual condition not found in powders made before the war and it seems reasonable to assume that some detail of manufacture was not carried out, and more than likely the neglected detail was in the nitration, purification or some other part of the manufacture wherein the chemical nature of the product was changed, but so slightly, that the powder, when tested chemically and ballistically by the Inspection Department at the time of manufacture, was found to comply with the details of the specification.

A further necessity for inspecting the process of manufacture is to be found in the nature of the chemical tests of the product. The only means available at the present time for determining, within a reasonable time, the stability of the ingredients of smokeless powder and of the powder itself are the potassium iodide starch test and the 135°C stability test. These are short time tests, consuming but a few hours, and they can hardly be expected to gage accurately the life of a powder and bring out defects, since the ratio of time consumed in the test, is too short in comparison with the life of the powder. Probably the most exacting and accurate test of the stability of a powder is the 65.5°C surveillance test, but this test cannot be applied to a powder which has been submitted for acceptance, as it takes months to complete the test. Only a quick method for determining the stability of a powder can be used.

There are a number of steps in the process of manufacture of smokeless powder, which if given special care tend to prolong the life of a powder; among these might be mentioned the purification of the raw cotton by means of the alkali treatment. If over treated the structure of the cotton is injured by the formation of oxycellulose, which when nitrated cannot be expected to produce a powder with the stability life of one made from cellulose which has not been over treated. In all probability, however, the stability of powder prepared from this degraded cellulose is not sufficiently impaired to fail to comply with the specification, but the defect, although not apparent at the time of manufacture, is quite likely to appear later. On the other hand the alkali treatment must be carried out sufficiently long that the oils and fats in the raw cotton are well removed, since these impurities if excessive are likely to cause fires in the wringers which receive the nitrated cotton directly from the nitrators.

In the production of any nitrate or nitro body the purification treatment has a particular bearing on the stability of the material. Such products can only be considered as properly purified when all traces of free acid have been absolutely removed without breaking down the nitrated material. To accomplish this purification, repeated boilings with frequent changes of water are necessary. In addition to boiling, the nitrocellulose is finely pulped in order to expose any acidity occluded within the fiber, to the action of boiling water. A small amount of alkali is added in order to remove the last trace of acidity. Numerous

boilings with frequent changes of water are necessary to purify the pulped material adequately.

After the nitrocellulose has been thoroughly purified, the moisture retained after centrifuging is replaced with alcohol. The specification requires that the alcohol used be of a certain minimum strength and that a minimum amount per pound of nitrocellulose treated be used. This is essential in order that the nitrocellulose be thoroughly dehydrated, as any water left resists the action of solvents used in the colloiding process.

Although no set time for mixing or definite proportion of ether to alcohol is prescribed by the specification, it does require that the mixing be continued until the solvent is uniformly distributed throughout the mass and that the proportion of ether and alcohol be such that the optimum colloid is obtained.

After the nitrocellulose has been thoroughly colloided and prepared for the graining process it is pressed into the desired size and cut into the required lengths. It is then given a solvent recovery treatment, the process for which is detailed in the specification, and it becomes the duty of the inspector to see that the temperature during the initial period of drying is not too high. This regulation of temperature is necessary to avoid the possibility of cracking the grains of powder or of causing them to become porous. It is also essential that the solvent recovery process be carried out in such a manner that a minimum amount of solvent is retained by the powder. This is not only economical, but insures against a partial reversion of the powder to ungelatinized nitrocellulose. This occurs if the powder is given the water drying treatment while the grains still contain an excess of solvent, since an ether alcohol solution of nitrocellulose is not miscible with water.

The temperatures during the final drying of the powder, whether by the water drying process or by dead air in a dry house must be carefully controlled in order to see that the specification for drying is being complied with.

After the powder has been dried to comply with the specification for total volatile content, it is necessary to give it a thorough blending in order that it may give uniform ballistics.

The Government having capable experienced inspectors to cooperate with the manufacturer, in giving attention to such details as are enumerated above not only insures a satisfactory product, but is also a great help to the manufacturer in making it more certain that his product will meet the specification and thus avoid to him the time and expense of reworking. The curtailment of production which would result if numerous lots failed to comply is of extreme importance to the Government when an emergency makes it necessary to obtain maximum production.

G. E. WEBSTER,
Picatinny Arsenal.

The Ninth Annual Meeting of the Army Ordnance Association

WILL BE HELD AT THE

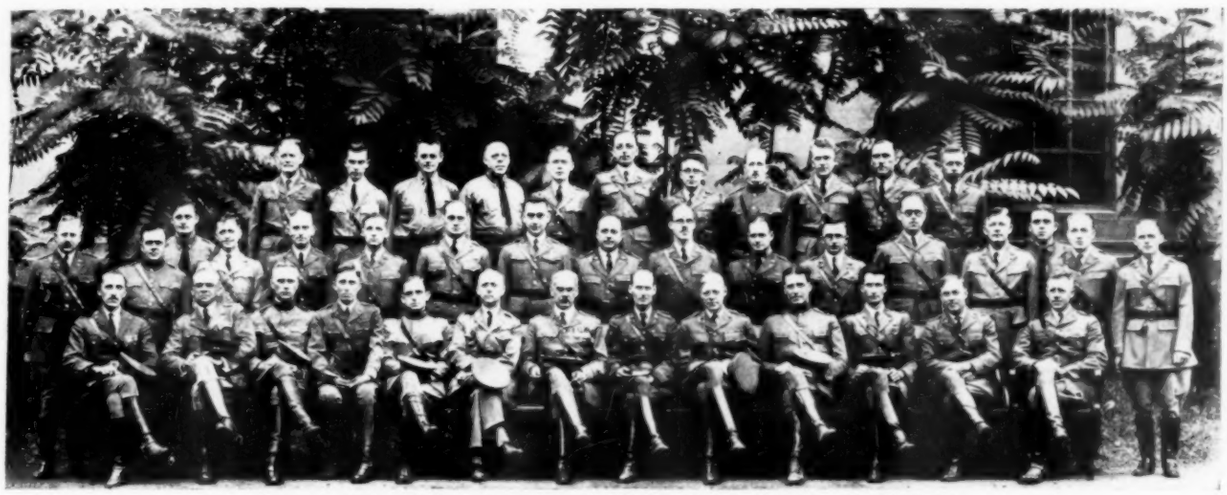
Aberdeen Proving Ground, Md.

Thursday, October 6, 1927

The Annual Meeting of the Association has become the Industrial Preparedness Day of the year.

All members of the Association are urged to attend. Personal invitations and complete details will be sent members on or about September 1, 1927.

Personnel



Reserve Officers' Training Camp, Rock Island Arsenal, July 10-24, 1927.

Left to right: Front row—1st Lt. W. S. Broberg, Maj. H. B. McKahin, Maj. H. B. LaRue, Maj. R. T. Olney, Maj. P. G. Blackmore, Lt. Col. G. F. Jenks, Col. D. M. King, Maj. K. B. Harmon, Maj. J. Clark, Maj. R. Bieber, Maj. R. C. Bodenhamer, Capt. J. F. Ballenger, 1st Lt. G. T. Rowland.

Middle row—Capt. H. O. Parker, 2nd Lt. T. O. Merchant, 2nd Lt. R. H. Morrison, 1st Lt. V. N. Charles, 1st Lt. G. L. Hunt, 2nd Lt. G. Oetinger, Jr., 1st Lt. H. L. Harms, 1st Lt. E. R. Lower, 2nd Lt. J. L. Scott, Capt. H. H. Hall, 1st Lt. R. H. Reid, 1st Lt. C. Hiller, Jr., Capt. L. A. Codd, Capt. H. E. Coleman, 2nd Lt. L. C. Ricketts, Capt. E. H. Sager, 2nd Lt. C. F. Criley.

Back row—Capt. W. Arthur, Capt. E. L. Lucas, 1st Lt. E. R. Page, 1st Lt. W. H. Bruhn, 2nd Lt. J. W. McCaffrey, Capt. C. A. Meyer, 2nd Lt. D. A. Reesor, Capt. J. M. Michaelson, Capt. O. M. Leath, 2nd Lt. A. D. Smith, 2nd Lt. E. Okey.

The Campaign of 1927 at Rock Island

THE Campaign of 1927—officially known as the Summer Training Camp for Ordnance Reserve Officers, July 10 to 24—at Rock Island Arsenal was a mighty strenuous one. The thirty-four Ordnance Reserve Officers who took part said that it was, and they ought to know. Col. D. M. King, Commanding Officer at Rock Island, expressed no opinion on this aspect of the matter, so one can't say that he was impressed by its strenuousness although he was good enough to express himself to the reservists in very complimentary terms on other phases of the matter, including deportment, interest and activity.

However that may be, the Campaign of 1927 at Rock Island was a mighty strenuous one. Being aroused from the gentle folds of sleep at 5 A. M. certainly gives the day a strenuous start. Being drilled by one Lieutenant Broberg, Ord. Dept., U. S. A., in every conceivable formation at quick time and double time, with one's trustry rifle embedding itself deeper and deeper in the none too fleshy precincts of the right shoulder, with the sun not yet above the broad expanse of the Mississippi, certainly continues the strenuous tendencies of the time. For, mind you, the Lieutenant shakes a wicked saber! Some day he'll handle his mashie with the same skill and precision. Drill over and with little intermission, off go the sturdy warriors to the various shops to study the ins and outs of every conceivable type of Ordnance and Arsenal procedure. And back again to the shops after luncheon for more study, and then to a lecture. And then to barracks with the same sun, not yet risen when the toil of the day began, fast sinking in what everywhere else they call the south, but what at Rock Island they say is west. And then supper followed by more study until the drowsy campaigners overcome by sleep quietly folded their mosquito netting about them and laid down to pleasant (?) dreams.

Imagine doing that for fourteen days running with little respite, day in and day out, can you not picture a strenuous campaign? Well, the thirty-four valiant campaigners said it was strenuous, and it was their campaign anyway.

You members of the Ordnance Reserve Corps who have never had inscribed on your service records a tour of active duty training at Rock Island have missed a big bet. Picture the huge establishment that Rock Island is, with its traditions running back to the days of Fort Armstrong

and the Indian Wars; located in the Mississippi River, a stone's throw from the Tri-Cities: Rock Island and Moline in Illinois, and Davenport in Iowa. Fancy an array of magnificent shop buildings erected just after the Civil War, built to stay, beautiful in design and imposing in serviceability. Picture the huge shops and warehouses constructed during the World War towering above the older structures and excelling them in size and modern appointments but not in beauty. Include in your panorama of Rock Island its drives and walks and stately trees, its power dam and plant, its proving ground, its cemeteries, National and Confederate, its club house and golf course. And include above all the group of Ordnance Officers of the Regular Army who are stationed there, a band of real gentlemen who know how to instruct and teach and make you feel at home, good fellows all of them. There's Rock Island for you—a great place at which to train, an even greater place when its importance in our scheme of national defense is considered.

The courses of study during the Campaign of 1927 were most interesting. Entirely practical, they were designed to acquaint the student officers with the ramified responsibilities of an Ordnance Officer. The curricula of both the basic and advanced courses aimed to refresh the minds of the students on matters with which they may have been familiar and to instruct them on subjects with which they had no acquaintance. To say that it was a practical exposition of the work of the arsenal is to describe the course in one phrase, for it was just that. Remember though that Rock Island has many irons in the fire. There is the huge machine shop where development and current repair and maintenance are carried on. There are the administrative offices where the planning, balance of stores, finance and other activities are conducted. There are the huge storehouses where the battle against deterioration goes on relentlessly. There is the great Field Service establishment where the Ordnance supplies for certain sections of the Army are kept and from which units in the field are supplied. There is the armory where small arms not handled with care in the field are repaired, inspected and reissued. There are the foundry, the laboratories and the Mobile Ordnance Company—all of them important cogs in the machinery. And there are many other departments and sections and all were down on the schedule of studies for the campaigners of 1927 to become acquainted with.

The campaigners themselves were a hardy lot, chief among them Lieut. T. O. Merchant of Beatrice (accent on the "at"), Nebraska, surnamed Commodore of the Horse Marines, K. C. B., whose slumber song, among other unexpected ventures, given in French at dinner at the club, took the entire company by surprise. Then there was the heroic Sager who during a fire which destroyed the Arsenal stables gallantly manned a nozzle and stood in the burning loft when all but he had fled. For his heroism he got all wet, and in addition received the commendation of the Commanding Officer and a leather medal of heroic size, suitably inscribed—the gift of his fellow reservists. Then there was the dapper McCaffrey, Second Lieut. Ord. Res., Sir, the life of the party, a heart-breaker if there ever was one, gifted pianist and less gifted golfer, who could think of more ways of making a fellow's bunk uncomfortable—even down right unlivable—than any of his fellows. And there were the studious Charles, the talkative Olney, the reserved La Rue, the serious McKahin, the affable Leath, the hilarious Hunt, the mischievous Meyer, and the rest. For the sake of the record, however, let's name them all as they come, without fear or favor: Majs. M. Bieber, R. C. Bodenhamer, H. B. La Rue, H. B. McKahin, R. T. Olney; Capts. W. Arthur, J. F. Ballenger, L. A. Codd, H. E. Coleman, H. H. Hall, O. M. Leath, E. L. Lucas, C. A. Meyer, J. M. Michaelson; First Lieuts. W. H. Bruhn, V. N. Charles, H. L. Harms, C. Hiller, G. L. Hunt, E. R. Lower, E. R. Page, R. H. Reid; Second Lieuts. C. F. Criley, J. Warren McCaffrey, T. O. Merchant, R. H. Morrison, G. Oetinger, E. Okey, D. A. Reesor, L. C. Ricketts, and J. L. Scott.

Finally a word of appreciation for the officers stationed at Rock Island who made the camp the real success it was. Colonel D. M. King could not have been more accommodating. He greeted the reservists with a welcome upon their arrival, he sang a solo for them at their dinner at the club, he came to their barracks and chatted with them of an evening. Maj. K. B. Harmon, Director of Training, endeared himself to the entire group. There's a man for you who knows how to run a camp. Personality plus—if you ask the officers who attended the camp. Lieut. Col. G. F. Jenks was credited by the reservists as having given one of the best lectures of the course when he addressed them on Artillery Matériel. Maj. P. G. Blackmore has a big job on his hands running the Field Service end of the works. There's no mail order house that can beat him at sending his customers what they want and when they want it. Lieut. W. S. Broberg, stern drill master that he was, knows his stuff. Even he seemed rather chesty when his rookies put on a regimental review at the end of camp and marched in company front after the manner of the far-famed "cadets." Lieut. G. T. Rowland, too, comes in for a big share of thanks. He was tireless in his efforts to make the camp a success, and if gratitude of the campaigners is any recompense he should know that all that he did was appreciated.

So there you are. The Rock Island Campaign of 1927 is a thing of the past. There is no doubt about it that it was exactly what a reserve officers' training camp should be; an intensive course of application, broken with an occasional bit of fun, presided over by men whose influence can only be for the best, attended by men who want to keep abreast of things that they may better fill their jobs whenever necessary—all in all a worthwhile undertaking, pleasing to those who attended, and of value, it is hoped, to the cause of national defense. L. A. C.

Changes in Instructions Relative to Administration of the Officers' Reserve Corps

THE Secretary of War has directed issuance of instructions for a number of changes in the administration of the Officers' Reserve Corps, exclusive of federally recognized National Guard officers. The effect of these changes will be as follows:

Whereas formerly promotion to fill vacancies was dependent upon a certificate of capacity, which was obtained only by conformity to a prescribed standard, the forth-

coming regulations will permit substitution of 300 hours' work in the preceding five years. Fifteen days' training will be counted as 100 hours of such work.

Time required in each grade prior to promotion will be as follows:

As a 2nd Lieutenant	3 years
As a 1st Lieutenant	4 years
As a Captain	5 years
As a Major	6 years
As a Lieut. Colonel	7 years
Total	25 years

For promotion above the grade of Major, in the cases of those who were not officers in the World War, qualifications must be shown either by graduation from the General Service Schools or by the passing of special examinations.

When vacancies exist and the Secretary of War authorizes promotion to the grade of Brigadier General in the Officers' Reserve Corps, selection will be limited to the eligible list of Colonels who have demonstrated their qualification by examinations and practical tests.

Whereas in the past in some cases assignment to units has been made of officers living outside the geographical areas of such units, hereafter promotion will be made to such vacancies from officers within the unit area.

More responsibility for administration of the Officers' Reserve Corps will be placed upon Reserve officers by provision for a board of Reserve officers, acting on an inactive status, in each Corps Area. These boards will advise on cases of separation and reappointment of Reserve officers, and also will advise Corps Area Commanders with reference to other questions pertaining to the Organized Reserves and the Officers' Reserve Corps.

The Unassigned Section of the Officers' Reserve Corps will be discontinued. In lieu thereof, the privilege of assignment, and active-duty training will be accorded only to those officers who, during the five-year period of an appointment, have obtained a certificate of capacity, performed 200 hours of military work, completed a correspondence school course, or obtained the necessary certification from their Chief of Branch.

Regardless of their eligibility for assignment, and active-duty training, all field officers may be reappointed in the same grade and branch. Captains and Lieutenants, however, having received one reappointment during which they were ineligible for assignment, and active-duty training, and not having maintained the required standards of work during this second appointment will be given a third appointment only upon the recommendation of a board of Reserve Officers convened in their Corps Area.

The Executive for Reserve Affairs will serve under the Assistant Secretary of War (Col. Hanford MacNider), to whom the Secretary of War has delegated supervision of the administration of the Officers' Reserve Corps and the Organized Reserves.

Recently Commissioned Ordnance Reserve Officers

THE following Reserve officers have accepted commissions since the last issue of ARMY ORDNANCE:

Lt. Col. Samuel G. Young, Ord. Res., 529 Hollywood Ave., Salt Lake City, Utah.

1st Lt. William J. Coleman, Ord. Res., 227 Norman Ave., La Salle, N. Y.

2nd Lt. Edward P. Adams, Ord. Res., 935 Regal Rd., Berkeley, Calif.

2nd Lt. Dave B. Allen, Ord. Res., 251 E. Mill St., Akron, Ohio.

2nd Lt. Amos E. Alsobrook, Ord. Res., 490 Hopkins St., S. W., Atlanta, Ga.

2nd Lt. Elmer Andrews, Ord. Res., 23 Merrymount Rd., Quincy, Mass.

2nd Lt. Arthur S. Ayres, Ord. Res., R. No. 2, Los Gatos, Calif.

2nd Lt. Augustus H. Batchelder, Ord. Res., 445 Turney St., Sausalito, Calif.

2nd Lt. Thomas C. Beatty, Ord. Res., DeFuniak Springs, Florida.

2nd Lt. Adelbert N. Billings, Ord. Res., 42 Vernon St., Brookline, Mass.

2nd Lt. Charles A. Bond, Ord. Res., Royston, Ga.

2nd Lt. George S. Brown, Jr., Ord. Res., 228 E. Bolton St., Savannah, Ga.

2nd Lt. Harry A. Brutsche, Ord. Res., 42 E. Boone Ave., Glenolden, Pa.

2nd Lt. John C. Butt, Jr., Ord. Res., Buena Vista, Ga.

2nd Lt. Philip J. Callan, Ord. Res., 161 Canal St., Lyons, N. Y.

2nd Lt. Joseph L. Carroll, Ord. Res., 343 E. 30th St., Baltimore, Md.

2nd Lt. James O. Clayton, Ord. Res., 434 Laurel Ave., San Anselmo, Calif.

2nd Lt. Laurence H. Coffin, Ord. Res., 232 Hollywood St., Dorchester, Boston, Mass.

2nd Lt. Harry Cole, Ord. Res., 2516 19th Ave., North Birmingham, Ala.

2nd Lt. Charles M. Colyer, Ord. Res., 1751 Post St., Jacksonville, Fla.

2nd Lt. John A. Connolly, Ord. Res., 3249 85th St., Jackson Heights, L. I., N. Y.

2nd Lt. Warren M. Craft, Jr., Ord. Res., 60 Mount Airy Road, Bernardsville, N. J.

2nd Lt. James L. de Jarnette, Ord. Res., Norcross, Ga.

2nd Lt. William L. Dever, Ord. Res., 305 E. Union St., Punxsutawney, Pa.

2nd Lt. Paul M. Edwards, Ord. Res., 68 Fair St., Atlanta, Georgia.

2nd Lt. Jackson Felmet, Ord. Res., 158 Pennsylvania Ave., Asheville, N. C.

2nd Lt. Homer D. Fincher, Jr., Ord. Res., Culloden, Ga.

2nd Lt. William H. Fincher, Ord. Res., Mountville, Ga.

2nd Lt. Elwood J. Fratis, Ord. Res., 713 15th St., Oakland, Calif.

2nd Lt. Clyde T. Furr, Ord. Res., Wesson, Miss.

2nd Lt. Alonzo F. Gaidos, Ord. Res., 436 Jefferson Ave., Redwood City, Calif.

2nd Lt. Charles E. Gammage, Ord. Res., 1009 Lee St., Americus, Ga.

2nd Lt. Wallace J. Greene, Ord. Res., 354 Washington St., S. W., Atlanta, Ga.

2nd Lt. Ernest L. Gunn, Jr., Ord. Res., Box 534, So. Jacksonville, Fla.

2nd Lt. Withers A. Haile, Ord. Res., Gainesville, Fla.

2nd Lt. Stephen E. Hall, Ord. Res., 94 Willowdale Ave., Montelair, N. J.
2nd Lt. Robert M. Harris, Ord. Res., 359 Orange St., Macon, Ga.
2nd Lt. Byron L. Hatherell, Ord. Res., Box 31, Roscoe, Los Angeles Co., Calif.
2nd Lt. Paul J. Hillegas, Ord. Res., 209 Williams St., Ithaca, N. Y.
2nd Lt. Lehman E. Hoag, Ord. Res., 207 Moore St., Waverly, N. Y.
2nd Lt. Arthur A. O. Hodge, Ord. Res., R. D. Box 403, Lomita, Calif.
2nd Lt. Kennan E. Hollingsworth, Ord. Res., 909 South Dakota Ave., Tampa, Fla.
2nd Lt. Ernest R. Huff, Ord. Res., Sherman, N. Y.
2nd Lt. Klein W. Kennedy, Ord. Res., 2111 Johnson St., Greenville, Tex.
2nd Lt. Floyd G. Kirkham, Ord. Res., 262 Lincoln Road, Brooklyn, N. Y.
2nd Lt. Benjamin L. Levinson, Ord. Res., 390 Marlborough St., Boston, Mass.
2nd Lt. Laurence Littlefield, Ord. Res., 8 Johnson St., Newburyport, Mass.
2nd Lt. James G. Luter, Ord. Res., care Mrs. T. S. Aderholdt, Jr., Friars Point, Miss.
2nd Lt. Edwin B. McCrohan, Jr., Ord. Res., 96 Grove St., New York, N. Y.
2nd Lt. Gordon I. McNeil, Ord. Res., 385 Winthrop St., Winthrop, Mass.
2nd Lt. Leil E. McVey, Ord. Res., Los Molinos, Calif.
2nd Lt. William Maddox, Ord. Res., 242 Harralson Ave., N. E., Atlanta, Ga.
2nd Lt. John F. Moffitt, Ord. Res., 404 16th Ave., San Francisco, Calif.
2nd Lt. Richard H. Mollenberg, Ord. Res., 959 Lafayette Ave., Buffalo, N. Y.
2nd Lt. William L. Morris, Ord. Res., 625 North 8th St., Columbus, Miss.
2nd Lt. George E. Munschauer, Ord. Res., 27 Dodge St., Buffalo, N. Y.
2nd Lt. James E. Nance, Ord. Res., Bell Buckle, Tenn.
2nd Lt. Merle E. Nantz, Ord. Res., 905 Evelyn Ave., Albany, Calif.
2nd Lt. Leroy M. Napier, Jr., Ord. Res., 202 S. W. 10th Ave., Miami, Fla.
2nd Lt. William Noonburg, Ord. Res., 89 No. Main St., Paterson, N. J.
2nd Lt. Eugene Odin, Ord. Res., 910 Union Ave., The Bronx, New York, N. Y.
2nd Lt. Benjamin B. Peacock, Ord. Res., 34 Inman Circle, Atlanta, Ga.
2nd Lt. Horace H. Peek, Jr., Ord. Res., Signal Mountain, Tenn.
2nd Lt. Ralph E. Pettit, Ord. Res., 120 Berkeley St., Valley Stream, L. I., N. Y.
2nd Lt. James L. Philips, Ord. Res., 357 Candler St., N. E., Atlanta, Ga.
2nd Lt. Charles P. Pinardi, Ord. Res., 4105 Garden Park Drive, Toledo, Ohio.
2nd Lt. Albert G. Pirkle, Ord. Res., Norcross, Ga.
2nd Lt. Joseph T. Pirog, Ord. Res., 415 E. 35th St., Savannah, Ga.
2nd Lt. Henry E. Powell, Ord. Res., 19 West North Ave., Atlanta, Ga.
2nd Lt. Joseph R. Pye, Ord. Res., 321 61st St., Brooklyn, N. Y.
2nd Lt. George Rezos, Ord. Res., 1632 Grant St., Berkeley, Calif.
2nd Lt. Norman L. Rowe, 3rd, Ord. Res., 236 W. Wilkins St., Jackson, Mich.
2nd Lt. Christian H. Schwingel, Ord. Res., 609 S. Few St., Madison, Wis.
2nd Lt. Robert W. Sherwood, Ord. Res., Benson Road, Fairfield, Conn.
2nd Lt. Sidney M. Smith, Ord. Res., 1025 St. Charles Ave., N. E., Atlanta, Ga.
2nd Lt. Clarence E. Sperry, Ord. Res., Box 1496, Tacoma, Wash.
2nd Lt. William W. Starke, Ord. Res., 18 Liberty St., Warsaw, N. Y.
2nd Lt. Joe N. Steed, Jr., Ord. Res., 810 Oak St., Macon, Georgia.
2nd Lt. Ernest L. Stephens, Ord. Res., Adairsville, Ga.
2nd Lt. Charles F. Sweet, Jr., Ord. Res., 69 Dryden Ave., Pawtucket, R. I.
2nd Lt. Frank L. Van Houten, Ord. Res., 43 Van Buren St., Kingston, N. Y.
2nd Lt. Roscoe Warnock, Ord. Res., Stilson, Ga.
2nd Lt. Francis P. Webster, Ord. Res., 8774 150th St., Jamaica, L. I., N. Y.
2nd Lt. Edward H. Wells, Jr., Ord. Res., 52 Midland St., Worcester, Mass.
2nd Lt. Harry E. Wheeler, Ord. Res., 8425 113th St., Richmond Hill, N. Y.
2nd Lt. Nicholas R. Wilson, Ord. Res., 1143 Spruce St., Berkeley, Calif.
2nd Lt. Lyndon R. Wine, Ord. Res., Fort Eustis, Va.
2nd Lt. Frank G. Wise, Ord. Res., 21 Woodland St., Newburyport, Mass.
2nd Lt. Morris B. Wright, Ord. Res., Parlin, N. Y.
2nd Lt. Edwin B. Zumwalt, Ord. Res., 7013 52nd Ave., S. E., Portland, Ore.

New York Ordnance Reservists Train

ARMY orders calling out Reserve officers of the 405th and 810th Ordnance Companies for summer training at Miller Field, Staten Island, issued July 27, 1927, by Major General James H. McRae, commanding the Second Corps Area, listed nine professional men residing within the Metropolitan Area.

The nine from the Metropolitan Area are Captain Charles W. Kingsbury, of 90 22nd St., Jackson Heights, L. I.; Captain John B. Cox, of Cherry Valley, N. Y.; Captain Louis J. Maidhof, of 21 Norman Place, Tenafly, N. J.; 1st Lieut. Joseph J. Smith, of Arcade, N. Y.; 1st Lieut. Clarence B. Mills, of 74 Kenwood Pl., East Orange, N. J.; 2nd Lieut. George F. Doughty, of 1328 Broadway, N. Y. C.; 2nd Lieut. Levi Ballard, of 61 Broadway, N. Y. C.; 2nd Lieut. John H. Sendelo, of 247 Huber Ave., Mt. Vernon, N. Y., and 2nd Lieut. Milton G. Maurer, of 154 E. 47th St., N. Y. C.

Patents

Brief Descriptions of Inventions of Interest to Ordnance Engineers

Complied by W. N. Roach, Chief, Patent Section, Office of the Chief of Ordnance

Ammunition and Explosives

THE following are some of the recent patents relating to ammunition and explosives:

Robert C. Moran, assignor to E. I. DuPont de Nemours & Co., has been granted patent No. 1,630,577 for a nitroglucoside explosive. The object of this invention is the preparation of a cheap low freezing explosive base which may be mixed with nitroglycerin thereby producing a more stable explosive mixture. The invention covers specifically the use of a nitrated glucoside of polyhydric alcohol.

Mr. Moran has also been granted patent No. 1,630,578, likewise assigned to E. I. DuPont de Nemours & Co., for a nitroglucoside explosive. This patent covers a nitrated glucoside of glycol.

Samuel Wiley, of Picatinny Arsenal, has been granted patent No. 1,632,156, for a universal system of identification markings for projectiles.

Earl J. W. Ragsdale, assignor to the Secretary of War, has been granted patent No. 1,632,147, for a dummy bomb. The main object of the invention is to produce a bomb body of plastic material with special means for anchoring the vanes to the bomb and providing for the production of a visible signaling when the bomb strikes.

Artillery

Some recent patents relating to artillery are as follows:

Pieter Van Essen and Clarence H. Froelich, have been granted patent No. 1,626,651, for a breech mechanism. This invention aims to provide a breech mechanism, intended primarily for use in trench mortars or the like, in which the breech block has formed therein a propellant charge chamber with restricted communication between the propellant charge chamber and the barrel of the gun. It is claimed that this structure allows a lighter gun barrel to be made and it also reduces the flash and smoke upon discharge of the gun.

Edward M. Hewlett and Waldo W. Willard, assignors to General Electric Company, have been granted patent No. 1,626,824, for a system of and apparatus for gun fire control. The invention aims to provide means for applying range and deflection corrections in the vertical and horizontal planes irrespective of the angular position of the gun.

Harry Hoisington, of Rock Island Arsenal, has been granted patent No. 1,626,826, for a shutter latch for shields. This invention is a special form of latch intended to hold the shutter of the gun shield in open and also in closed position.

Patent No. 1,627,836, for a trail connection, has been granted to Thomas A. Conlon, of the Office of the Chief of Ordnance.

Patent No. 1,628,165 has been granted to Lawrence W. Luellen, for a system of mobile armament. The main object of this invention is the provision of a special form of support adjacent to a railway track and extending longitudinally thereof, together with a specially constructed car adapted to cooperate with said support to receive the shock of firing heavy ordnance from the car.

August Dabrasky, of the Office of the Chief of Ordnance, has been granted patent No. 1,629,683, for a semi-automatic rammer for guns. The main object of the invention is the provision of a rammer which will be set in operative position by recoil of the gun and which will move on recoil a distance sufficiently greater than the length of recoil of the gun to permit the insertion of the charge ahead of the rammer.

Heinrich Romberg has been granted patent No. 1,629,739, for a gun carriage. The invention aims to provide a gun carriage having an axle which will permit of adjustment so as to level the gun and also of adjustment of the firing height of a gun.

Jacob L. Young has been granted patent No. 1,630,686, for an apparatus for grinding gun barrels. The invention aims to provide a tool for grinding the barrel by the use of an abrasive paste and means for feeding the paste to the interior of the gun barrel.

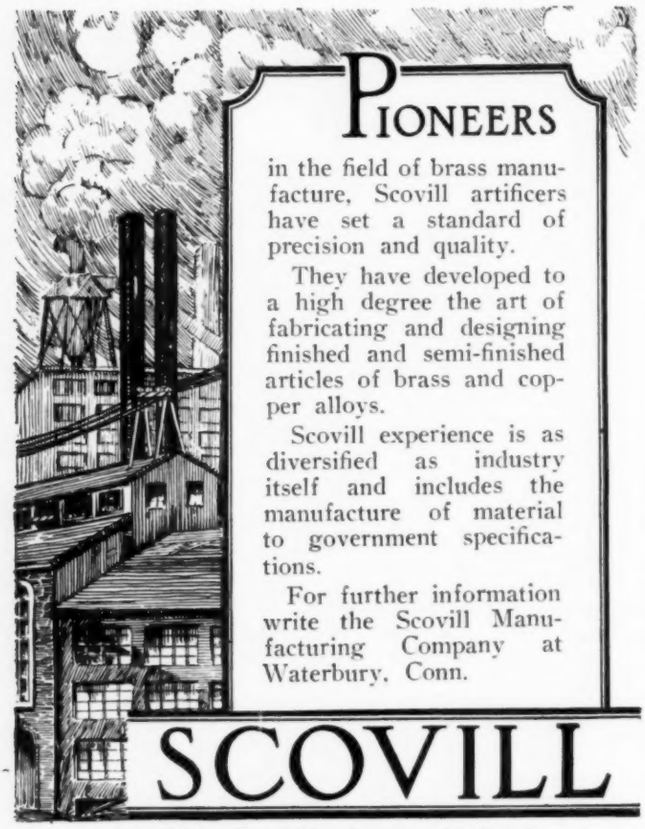
James C. Karnes, of the Office of the Chief of Ordnance, has been granted patent No. 1,631,211, for a mechanism for setting fuzes within guns. This invention provides a mechanism for setting a fuze, after the round has been placed in the gun, which may be operated either manually or coupled to a fire control apparatus, by which the equivalent of fuze range is automatically and continually introduced into the mechanism.

Small Arms

The following patents relate to small arms:

Patent No. 1,628,798, for a firearm, has been granted to Chas. A. Nelson, assignor to Savage Arms Corporation. This invention has special reference to the construction of the frame of side lever action rifles and the main object sought is lightness of weight, cheapness of structure, together with efficiency and durability.

John M. Browning, deceased, has been granted patent No. 1,629,651, for a firing mechanism for automatic firearms. The main object of the invention is the provision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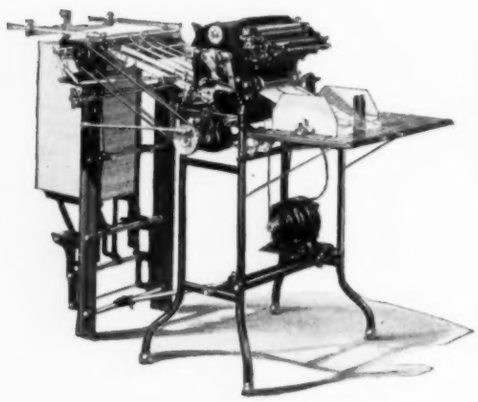

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of a firing mechanism in which the firing member, while securely held, may be released by the application of a small force, thereby rendering the device particularly applicable for firing by means of a trigger motor.

The same inventor has also been granted patent No. 1,629,592, for a cartridge feeding mechanism for automatic firearms. The main object of this invention is the provision of a rotary drum type of feed mechanism for automatic firearms.

Patent No. 1,629,794 has been granted to Joseph E. T. Jacquemin and Morris P. C. Frère, for a target practice device.

Gustavo Nicholson has been granted patent No. 1,630,404, for firearms. The invention relates primarily to a revolver, and aims to provide a hammer which may not be accidentally released when cocked, a proper housing to close the mechanism against the entrance of dust, and further to provide means for freely opening the firearm for the discharge of empty shells.

William R. Bull, of Springfield Armory, has been granted patent No. 1,631,190, for a method of and an apparatus for cooling gun barrels. The invention relates to a specific form of pump for supplying water to the water jacket of a machine gun.

Patent No. 1,631,242, for a bolt action firearm, has been granted to Frank F. Burton, assignor to Winchester Repeating Arms Company. The invention aims to provide a bolt which will not cramp in either its forward or rearward positions.

Karl J. Glans and Jöns E. Glans have been granted patent No. 1,632,892, for a firearm. The main object of the invention is to reduce the inertia of the firing pin and the period of time lapsing between the action on the trigger and firing of the cartridge.

John A. Dickerman, assignor to Remington Arms Company, Inc., has been granted patent No. 1,633,168, for mushrooming bullets. The invention aims to provide a jacketed bullet having a soft core with a deformable point projecting forwardly of the jacket, with a coating of protecting and reinforcing material deposited on and covering the point.

Military Inventions

THE knowledge of military devices which became widespread through contact of American soldiers and interested civilians with such equipment during the World War has been reflected in a great increase in the number of inventions relating to such equipment which are daily submitted to the War Department. The War Department considers that it is desirable that every such idea which is presented should receive careful scrutiny so that advantage will be taken of all of the possibilities of these various inventions.

In order that proposed inventions may be considered adequately, each of these upon receipt is submitted to a Technical Committee composed of representatives of all interested branches of the Army. This committee studies the invention, analyzes its defects as well as its merits and reports whether in its opinion the War Department should become interested in the development and perfection of the idea. The report of this committee is submitted to the War Department, which advises the inventor of its final decision.

Books

Military Organization of the United States. Fort Leavenworth, Kansas: The General Service Schools Press. Revised November, 1923. 1926.

A PAMPHLET just printed in 1922 to fill a distinct need at the General Service Schools at Fort Leavenworth and intended as a reference for use by military students. In the few pages of this small handbook the reader can find a clear outline of the basic military organization of our nation which is the direct result of our 150 years of national life and the indirect result of the military experience of the ages.

Everyone in the military service from raw recruit to four-star retired general can profitably take an occasional hour off to read and study what has been written on that all-important subject of organization. For the civilian with even a meagre curiosity about the whys and wherefores of the military service this semi-official document will answer many questions and furnish food for further thought.

History of Fort Leavenworth, 1827-1927. By Major Alvid Hunt, Infantry, U. S. A. Fort Leavenworth: The General Service Schools Press. 1926.

IT is especially fitting that the attention of members of our military family should be called to the one-hundredth birthday of Fort Leavenworth by the publication of Major Hunt's book. With the exception of West Point there is no military establishment in our country which has contributed more to the profession of arms than Leavenworth and the reader of Major Hunt's attractive volume cannot fail to begin to understand why this is so.

Ordnance readers will be pleased and perhaps surprised to find what a material contribution "The Leavenworth Arsenal" made to the existing facilities of Fort Leavenworth, even the Commandant's quarters having been for many years the Arsenal Commander's quarters.

To everyone who has ever served at Fort Leavenworth in any capacity and to everyone who ever expects to include a term at Post, School or Prison in his career, Major Hunt's work is recommended and let us hope that he will be inspired to do as much for many of our other military posts whose fame is as yet unsung.

The Spell of French Canada. By Frank Oliver Call. Boston: L. C. Page & Company. $3.75.

THAT a bit of old France, the last remnant of the great empire built by Cartier, Champlain, Maisonneuve, and a host of other hardy pioneers, still exists on this continent in the midst of a British dominion, is well known to everyone. The author has sought to analyze the spell of this interesting section of Canada from the sympathetic viewpoint of one who has lived among the people and appreciated the spirit of the country. Description is interspersed with history and folk lore forming a graphic background for the modern life of the French-speaking habitants. Quebec and Montreal in all of their uniqueness form interesting chapters and the countryside is dealt with from the first hand impressions of the author as he traveled from place to place.

The Study of War. Edited by Major-General Sir George Aston, K. C. B., with introductory address by The Right Hon. Viscount Grey of Fallodon, K. G. New York: Longmanns, Green & Co. 1927. $3.75.

THIS volume is a compilation of lectures delivered in the University of London on the nature and conduct of warfare. Each subject is treated by an expert in his line well qualified to direct and mold public thought on the necessity of adequate military defense.

The lectures on the four fighting Services, namely: "Sea Warfare," by Admiral Sir H. W. Richmond; "Air Warfare," by Air Vice-Marshal H. R. M. Brooke-Popham; "Chemical Warfare," by Brigadier-General H. Hartley; and "Land Warfare," by Major-General Sir E. Ironside, are clear cut and convincing arguments for the necessity and maintenance of those branches. As would be expected, the two lectures on "Sea Warfare" are most excellent presentations of the Naval problem and would easily persuade any Britisher to support any Naval program to the limit, especially one for capital ships. As the editor points out: "It is interesting to note certain divergences between the airman's and the seaman's conception of strategical objectives, in-so-far as it effects, more especially, the need for battles to achieve a common purpose."

The other lectures—"The Study of War for Statesmen and Citizens," by the editor, and "Military History," by

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Sir Charles Oman, M. P., and a paper by G. F. Bridge on "What Should We Teach About War?"—show the need of teaching laymen the origin, nature and conduct of warfare as affected by present day conditions.

Statesmanship or War. By John McA. Palmer, Brig. Gen., U. S. A. (retired). New York: Doubleday, Page & Co. 1927. $2.50.

GENERAL PALMER rendered great service to the nation by his wise counsel and masterly presentation of facts to the Senate Military Affairs Committee when the National Defense Act was being rewritten in 1919 and 1920. In the present volume he appeals to the nation for a proper logical defense policy and an economical and efficient National Defense organization.

He advocates a single Department of National Defense having control of the policies of the Army, Navy and Air Forces; the administration of these, however, to be conducted by the present offices modified as need be by our enunciated defense policy. Economy and efficiency may be attained, he says, and the spirit of the National Defense Act upheld by an adaptation, for the Army, of a system similar to that in operation in Switzerland which prescribes a small standing army, and a call to the colors each year for a short training period of certain of her male citizens who, in effect train themselves, this being in reality an enlargement on Washington's much pleaded policies of our early history.

In a masterful, clear, and logical manner he shows that offensive armaments have the evil effect of provoking war and that defensive armaments tend to prevent war, and points to the advantages of the limitations of standing armies as a guarantee of peaceful intentions of nations.

This book should be read by all interested in the welfare of the nation.

The Revolt of Asia: The End of the White Man's World Dominance. By Upton Close (Josef Washington Hall). New York: G. P. Putnam's Sons. 1927.

THE author has drawn liberally on his extensive first hand knowledge of the peoples and polities of Asia, which he has gained by intimate contact, close observation and careful analysis, to present to his readers a very clear, forceful picture of the most probable course of future events in Asia. At the same time he shows the international influences towards peace and war and assigns to America a very strategic position for aiding the inevitable rise of Asian peoples to demand control of their own destiny so as to result in a peaceful and harmonious White and Colored Man's joint world wherein "each shall have control in his own house and proportionate say in the general convocation of humanity."

This is a very timely and worth while book, one which should awaken the thinkers of our country and one which carries a message which should be heeded by all.

The Meaning of a Liberal Education. By Everett Dean Martin. New York: W. W. Norton & Company. 1926. $3.00.

THIS is a truly remarkable collection of essays on the broader aspects of education as it affects the whole life of any intelligent person. The author is not concerned with pedagogies but with that greater and more important education which an adult gets as the result of rational

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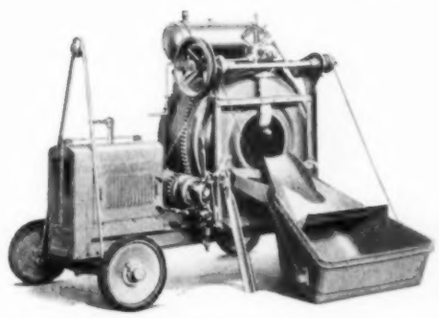

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thinking applied to the raw material gathered from his reading and experience. After taking up such educational aberrations as "animal" training, propoganda, and book learning (the too ready acceptance of a statement because it is printed), Martin devotes several chapters to describing the type of mind required to acquire and enjoy a liberal education. The book closes with interesting chapters on some men who embodied the open mind and the free spirit of an educated person: Plato, Aristotle, Erasmus, Montaigne, and Huxley. The author says: "Education is emancipation from herd opinion, self-mastery, capacity for self-criticism, suspended judgment, and urbanity." This excellent book can be read with profit and enjoyment.

Benjamin Franklin: The First Civilized American. By Phillips Russell. New York: Brentano's. 1926. $5.00.

THIS delightful modern biography shows that while the thrifty patriot of the school histories was no puritan he was a much greater American than is generally thought. Russell has written with an open mind in an easy style. Franklin's youth is rendered in more detail than is customary in biographies, by which there is not left the usual impression that great men demonstrate their greatness right from the cradle. While Franklin's versatile genius is continually emphasized his work as a statesman is not given in sufficient detail to make the book a complete biography. The author makes clear that Franklin was truly "civilized," that is, he was tolerant; was not devoted exclusively to wealth (as his proverbs indicate); served his country well; and had an intelligent interest in science, literature, people, and the amenities of life. Some rare material is included. The book leaves one with greater admiration and a sincere affection for Poor Richard.

The Romance of the Atom. By Benjamin Harrow. New York: Boni & Liveright. $1.50.

MAKING available to the public of limited scientific education the latest discoveries concerning the ultimate structure of matter (or what is believed at present to be the ultimate) is an achievement that Mr. Harrow has accomplished in a highly satisfactory manner in his book on the atom. Proceeding chronologically from the early work of Priestley and Lavoisier in chemistry, through the development of the atomic theory, to Mendelief and the periodic law, we finally reach the astounding investigations of the modern physicists and chemists. In a few hours one can pass in review in an interesting narrative the steps that finally led to our present knowledge of the atom and the simple explanation of chemical combinations. It is a book that can profitably be read by one whose studies of physics and chemistry were not made within the last ten or fifteen years.

Statistical Methods. By Frederick Cecil Mills, Associate Professor of Business Statistics, Columbia University. New York: Henry Holt & Co. 1927. $3.60.

QUANTITATIVE methods of research have become the function not only of the laboratory worker, but also of the economist, the business man, and the army officer. The tendency towards a more extensive use of statistics makes a knowledge of the principles of this science more and more essential. It is not easy to find a book on statistics that maintains just the desired balance between simplicity of exposition and adequacy of treatment, and it is

consequently a pleasure to bear witness to the unusual success of Professor Mills in accomplishing this end in "Statistical Methods." The book covers all the usual phases of statistics with especially satisfactory treatment of Index Numbers and Probability, and can readily be employed as a text-book for the individual studying without an instructor.

Man is War. By John Carter. Indianapolis: The Bobbs-Merrill Co. 1926. $3.50.

THIS book by a young journalist and diplomat is an able, interesting, and informal discussion of the causes of war. The central theme is that *man is war,* that is, conflict in some form is a concomitant of all active living; war is only the ultimate in such conflict. The argument is based almost entirely on contemporaneous history, which renders the book less enduring. One of the most significant chapters deals with religion as an important cause of war. That most important factor in international relations, the economic element, is exceptionally well handled. Carter says: ". . . . the United States presents a spectacle as tempting as a little Lord Fauntleroy brandishing a bag of lollipops in the face of a back-alley gang of slum boys." Without denying the possibility of world peace the author shows it to be highly improbable under our Atlantic civilization which is based mainly on self-perpetuation and self-aggrandizement.

From Double-Eagle to Red Flag. By General P. N. Krassnoff. New York: Duffield and Company. 1927. 2 Vols. $7.50.

THE first volume of this thrilling historical novel gives us vivid pictures of Russian life under the Czar, whose influence is unbelievable. The almost idolatrous worship of him is an illuminating bit in the character of the Russian people. Without this outlet of adoration and complete trust one understands how easily the idea of Revolution seized on the Russian mind. The rest of this volume treats of the Japanese War and the beginning of the World War. Underlying all is the realization of the slow disintegration of Russia as an empire. A current of melancholy and gloom, a feeling of frustration and futility pervades the book. Through Sablin, the character about whom the story revolves, his doubts, fears and struggles, we are made to realize the difficulties which beset the finer, most loyal type of educated Russians in their efforts to preserve Russia and the Czar, whom they had always loved and revered.

The second volume deals chiefly with the horrors and unvarnished truths concerning the Revolution, the Civil War and finally the life of Russia under Bolshevik rule. No stronger argument against the Red rule could possibly be voiced than comes to us through this vital book written in the heart of a country given over entirely to Bolshevism.

The Twilight of the White Races. By Maurice Muret. New York: Charles Scribner's Sons. Translated by Mrs. Touzalin. 1926. $3.00.

THIS French writer discusses intelligently and dispassionately the no longer novel idea that the white, Western, or Atlantic cizilization is losing its world supremacy. He writes opportunely at a time when the leading white nations are engaged in various forms of conflict with their respective political and commercial subject races in China,

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Latin America, India, Africa, and other places. While not predicting immediate disaster for Europe (less Russia, which Muret considers Asiatic) and the United States, he shows that the great numerical inferiority of the highly cultured white imperialistic races is steadily being made more serious because the spreading of industrial "civilization" only among the other races is making them more powerful, acquisitive, and independent. Wilson's theory of self-determination and Bolshevism are given about equal credit for the awakening of the non-white races. Each chapter is followed by a bibliography, but there is no index. This is an important book on a subject that closely concerns the future of our country.

An Aide-de-Camp of Lee. The Papers of Col. Charles Marshall. By Maj. Gen. Sir Frederick Maurice. Boston: Little, Brown & Co. 1927. $4.00.

BY editing these papers of Colonel Marshall, General Maurice has added greatly to his exceptionally interesting and valuable contributions concerning the Civil War and its more prominent participants and has presented some authoritative information heretofore unavailable to the public.

The influence of the political situation of the South on its military efforts is most illuminating.

The tactics of Lee, his strategy, and the main causes of the most critical reverses he sustained are masterfully analyzed.

The exposition of the causes of Jackson's delays in the "Seven Days" and the part he played in occasioning the second Battle of Manassas are enlightening. The true facts concerning Jackson's flank march around Hooker at Chancellorsville are brought out. The account of Gettysburg and the story of Stuart's long separation from the Army because of faulty orders and the resulting consequences are made clear.

This is unquestionably a sincere, truthful, and unbiased historical work and one in which the agony attending civil strife is keenly depicted. Especially touching are the final scenes at Appamattox, where the true characters of Grant and Lee are clearly shown.

The Bridge to France. By Edward N. Hurley. Philadelphia: J. B. Lippincott Company. 1927. $5.00.

THIS volume is an invaluable addition to the increasing list of books which collectively comprises the history of the World War. It is delightfully written and tells in an inspiring and interesting manner the story of the magnitude of the accomplishments and degree of success attained during the war by the U. S. Shipping Board and the Emergency Fleet Corporation. Many side lights are thrown on the characters of the many efficient and able men who made possible the herculean results of building, equipping, maning, protecting, and operating our war-time built merchant marine. An insight is given to the governing factors of a military policy in which maritime transportation holds a position of paramount strategic importance and the question is raised as to whether or not lack of a proper merchant marine invited the submarine warfare. Interesting examples of European diplomacy and vivid accounts of the Treves, Spa, Brussels, and Paris Conferences are illuminating.

Of equal interest perhaps are the post-Armistice settlements, the activities of the American Relief Association and of the Supreme Economic Council. Mr. Hurley is opposed to an industrial draft law and such an opinion from one so eminently fitted to give wise counsel should be carefully considered in solving our future emergency munitions problems. This book is recommended to all interested in war or industrial history.

The Services of Supply. By Major General Johnson Hagood. New York: Houghton Mifflin Company. 1927. $5.00.

GENERAL HAGOOD has written an unusual book, in that he effectively combines an interesting personal memoir with a valuable study of staff organization.

His position as Chief of Staff at Tours gave him exceptional opportunity to observe and analyze the growth of the Lines of Communication, or Services of Supply as it was later unhappily termed.

An early chapter gives a lucid and interesting account of our ante-bellum War Department and an amusing account of the utterly unessential deliberations of the General Staff prior to 1910.

The real story starts in Chapter IV when General Hagood is selected to command the Advance Section, Lines of Communication of the A. E. F.

A very interesting but unofficial story is given of why General Harboard succeeded General Kernan; more light on this subject would be of great historical value.

Too much space is devoted to the friction which existed between the Transportation Department and the Command of the S. O. S.

The final chapter contains a rather controversial analysis of the War Department and errs in implying that G-2 conducts espionage of Americans in time of peace. An announced policy of the War Department states that in time of peace it does not investigate individuals.

An excellent index is one of the many good features of this book.

Napoleon. By Emil Ludwig. Translated by Eden and Cedar Paul. New York: Boni & Liveright. 1926. $3.00.

A FAMILIAR but always interesting subject is presented in a new manner by a distinguished German author. Unlike most biographies of Napoleon, it is a character study and not merely a study of his military campaigns. The analysis is further distinguished by being based principally on abundant quotations from his sayings and his voluminous writings, thus making the book vivid.

Napoleon's enormous executive ability, excellent intelligence, great industry, and impersonal disdain for mankind are shown to have made him a great paternalistic ruler who fostered progressive government institutions, learning, industry, and commerce. The intense isolation of this great man in the pursuit of his worthy ambition of a unified Europe and his struggles with mediocrity and disloyalty in friends and subordinates are skillfully drawn. This book will do much to offset Wells' condemnation of Napoleon in "The Outline of History," particularly since one cannot, after reading Ludwig's "Wilhelm Hohenzollern," accuse the author of sympathy for megalomania or military autocracy. Napoleon is pictured as a versatile genius

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who is too often condemned because he dealt with men as a realist and not as an idealist.

This book is very enjoyable; it is an outstanding and valuable work. There are twenty-one portraits of Napoleon; it is attractively printed and bound, with a good index.

Statesmen and Soldiers of the Civil War. By Major General Sir Frederick Maurice. Boston: Little, Brown & Company. 1926. $3.00.

THESE studies of the relations which existed between statesmen and soldiers during the course of a prolonged war were delivered as the Lees-Knowles Lectures for 1925-26 at Trinity College, Cambridge.

It is not often we have the opportunity to reflect on the actions of men prominent in American history presented by so unbiased and impartial as well as by so eminently qualified an authority as we have in this book by Maurice.

The relations of Jefferson Davis and J. E. Johnston; Davis and Lee; Abraham Lincoln and McClellan, and Lincoln and Grant are set forth in a new light. It is refreshing to have the relations which existed between two statesmen and four soldiers during a great war, under democratic systems of government, critically but impartially examined and a new light thrown on the conduct of war which should be considered carefully and thoughtfully by all—especially those upon whom the conduct of war would devolve.

War Birds. Diary of an unknown aviator. New York: George H. Doran Company. 1926. $3.50.

A DIARY of an anonymous American aviator serving at British schools and with British squadrons at the front.

A frank and clever story of flying, of ambition, of drinking, loving, fighting and of death. The hand of discipline felt heavy when it rested but apparently this was not often. The story, though light, is of interest to those who are attempting to complete a picture of combat in the recent war. The air battles are described vividly and furnish us an idea of what the airman thinks about.

One is sorry that the diary ends and that the story of the authors last fight must remain untold for he was killed behind the German lines a short time before the Armistice.

World War Debt Settlements. By Harold G. Moulton and Leo Pasvolsky. New York: The MacMillan Company. 1927. $2.00.

THIS small volume deals with the Government debts of all the Allies due to the World War and with Germany's reparation obligations. It sets forth in a clear and concise manner the debt problems as they affect each country and the origin and size and the plans for their eventual settlement. The first chapter is particularly illuminating, as it describes the processes involved in paying any international debt and their application to the cases in hand. At the end of the volume is printed the full text of all the important documents treating of war debt and reparation settlements. It is written in such a manner that it is very interesting and intelligible to the lay mind.

The New Universe. By Baker Brownell. New York: D. Van Nostrand Co. 1927. $4.00.

THE author informs his readers that this book is a smuggling expedition in knowledge and in every sense of the word such it is, for one is taken quickly in a thorough

and scholarly way through the new sciences and given a complete survey of the problems of the world without the necessity of laboring through many volumes, as is the more usual method. In small space is made readily available much food for thought concerning the universal processes, the dynamic conception of life, social policy, and the spiritual and practical approach to the world.

An understanding of the ideas and principles enunciated by Baker Brownell will produce more intelligent and productive thinking. The reader's interest will doubtless be aroused and he will demand further investigation in various lines of thought and for such persons the author has included a comprehensive list of references and books for collateral reading in the many and varied subjects discussed. A very brilliant and stimulating addition to literature.

France. By Sisley Huddleston. (The Modern World series, edited by the Right Hon. H. A. L. Fisher, M. P.) New York: Charles Scribner's Sons. $5.00.

MODERN France interpreted as the resultant of the economic, financial, political, social, and religious forces taking root in the monarchy, passing through the storm and stress of revolution, the Napoleonic era, and the many changes of the nineteenth century, is the theme of this volume in the "Modern World" series. Mr. Huddleston has analyzed the French psychology with the sureness of one who knows his subject thoroughly and with the sympathy of one who loves French civilization. There is no fulsome praise, however, for the shortcomings of the nation, especially from the point of view of political organization, are fully described along with the achievements. No one can read this book, even after long years of residence in that country, without gaining a clear insight into the reasons for French political and diplomatic action, and into the social and religious life of a nation which, although a republic, differs in so many respects from the republican institutions as we know them in our own country. The very important changes in the economic situation of the country as a consequence of the War are fully developed.

The book accomplishes the useful purpose of providing an authoritative source of information, attractively presented, concerning all phases of modern France down to the accord reached with Germany at the Locarno conference.

Graphic Charts in Business. By Allan C. Haskell. With an introduction by Richard T. Dana. New York: Codex Book Co., Inc. 1926. $4.00.

IF Mr. Haskell's book included nothing beside his clear explanation of the usefulness of logarithmic charts and the comparison of the arithmetic chart with this too little understood method of plotting, it would be a most valuable contribution to the growing literature on the subject of graphic statistical methods. The method of approach by the solution of concrete problems in large numbers with numerous well-made charts of every type facilitates the study of this subject which is excellently presented throughout. Other chapters treat of trilinear charts, probability charts, charts for prediction and trend, charts in the purchase and sales departments, charts applied to scheduling and production, charts for stock and bond prices.

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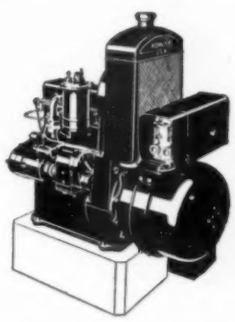

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Covering Washington. By J. Frederick Essary. Boston: Houghton Mifflin Co. 1927. $3.00.

WITH the passing years, Washington assumes a more dominant position in the life of the country, as the growing centralization of power in the hands of the federal government has tremendously augmented the importance of the city. The nation looks more and more to Washington in all its affairs, and that it may be better understood the Washington correspondent of the *Baltimore Sun* has rendered a real service in revealing the human element in the judiciary and in the legislative and executive branches of our government.

A most entertaining opening chapter on "Our Town" deals with social life in the capital, and the chapters on diplomatic life, the lobby, and the activities of the press give the reader an illuminating picture of these phases of our Government. It is a decidedly worth while description of what goes on behind the scenes in the national capital.

Business Without a Buyer. By William T. Foster and Waddill Catchings. Boston: Houghton Mifflin Company. 1927. $2.00.

HOWEVER much one may disagree with the economic theories of Messrs. Foster and Catchings, there can be but one opinion relative to the success those authors have met in stimulating popular thought and discussion in a domain formerly reserved to the elect few. Many orthodox economists look askance at their theory of undereonsumption resulting from corporate and individual savings as the basic cause of business depressions, but it seems more plausible than the majority of the reasons advanced by economists to explain the alternate periods of prosperity and depression in business. "Business Without a Buyer" is a popularization of the authors' theories previously advanced in "Money" and "Profits." No knowledge of economics is required to understand the thesis of the book which, in presenting a novel and helpful point of view in practical affairs, should be read by everyone having the slightest interest in business.

Battleships in Action. By H. W. Wilson. Boston: Little, Brown & Company. 1926. 2 Vol. $10.00.

THIS work by a well-known English writer on naval subjects is a complete history of naval war from the introduction of armor to the close of the World War. Although the history is detailed and technical the author's style is such that the book is highly entertaining.

Volume I covers the period from our Civil War to the World War. This volume is of particular interest to us because of the foreign point of view thus obtained of the important actions of our Navy during this period. Volume II is the naval story of the World War and while thus of greater immediate interest the historical perspective is naturally not as good as in Volume I. The point of view is British but is singularly detached, as for example in the reflections on the Battle of Jutland (page 189) where the author says: "It was, however, an indecisive engagement; . . . . ." On the other hand, the important part taken by the United States Navy is too briefly treated. Both volumes have the cumulative effect of bringing out the importance in naval warfare of superior matériel and the inexorableness of the basic principles of war.

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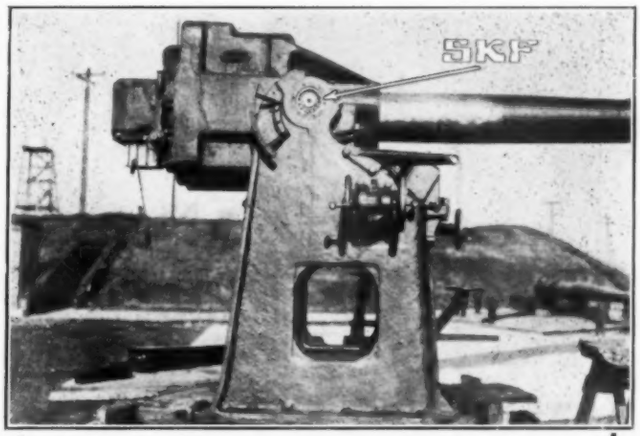

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